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Focused Feasibility Study
for
Site 1 - Golf Course Landfill
and
Site 4 – Fire Fighting Training Unit

Naval Station Great Lakes
Great Lakes, Illinois

Naval Facilities Engineering Command Midwest

Contract Number N62467-04-D-0055

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FOCUSED FEASIBILITY STUDY

SITE 1 - GOLF COURSE LANDFILL AND SITE 4 - FIRE FIGHTING TRAINING UNIT

NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criterion
BAF	Bioaccumulation Factor
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	Centimeters
COC	Chemical of concern
COPC	Chemical of potential concern
CSF	Cancer Slope Factor
CWA	Clean Water Act
EEQ	Ecological Effects Quotient
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
FFS	Focused Feasibility Study
ft2	Square foot/feet
GRA	General Response Action
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
Illinois EPA	Illinois Environmental Protection Agency
ILCR	Incremental Lifetime Cancer Risk
K	Horizontal hydraulic conductivity
LUC	Land Use Control
MCL	Maximum Contaminant Level
mg/kg	Milligram(s) per kilogram
MOA	Memorandum of Agreement
μg/kg	Microgam(s) per kilogram
NAVFAC Midwest	Naval Facilities Engineer Command, Field Division South
NCP	National Oil and Hazardous Substance Pollution Contingency Plan (also called the National Contingency Plan)
NEPA	National Environmental Policy Act
NPW	et present worth

O&M	Operation and maintenance
OSHA	Occupational Safety and Health Act
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI/RA	Remedial Investigation/Risk Assessment
RME	Reasonable Maximum Exposure
SERA	Screening-Level ERA
SVOC	Semivolatile organic compound
TACO	Tiered Approach to Corrective Action Objectives
TBC	To Be Considered (criterion)
TSDF	Treatment, storage, and disposal facility
TtNUS	Tetra Tech NUS, Inc.
µg/L	micrograms per liter
USC	United States Code
U.S.	United States
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compound
yd^3	Cubic yards

EXECUTIVE SUMMARY

E.1 PURPOSE OF THE REPORT

The purpose of this Focused Feasibility Study (FFS) is to develop and evaluate options for the remedial action for Site 1 – Golf Course Landfill (aka Willow Glen Golf Course) and Site 4 - Fire Fighting Training Unit (FFTU), at the United States (U.S.) Naval Station Great Lakes located in Lake County, Illinois, under Contract Task Order 506. This FFS describes the basis for and the evaluation of remedial alternatives for Sites 1 and 4 (Site).

E.2 SITE DESCRIPTION AND HISTORY

Site 1 is currently a golf course. A portion of the site was a landfill that operated between 1942 and 1967 as a trench/burn facility. The landfill was operated on approximately 50 acres that is now covered by the western part (back nine) of the golf course. It received an estimated 1.5 million tons of material during its years of operation. Types of waste reportedly disposed at the landfill included domestic refuse, sewage sludge, petroleum, oil, and lubricants, solvents, coal ash, and materials contaminated by polychlorinated biphenyls (PCBs) (C.H. Guernsey, November 2002).

A dragline was used for excavation of the trenches. Each trench was approximately 8 feet wide and was dug to at least the top of the water table [reportedly 6 to 8 feet below ground surface (bgs) in this area]. Occasionally, the trenches had several feet of standing water in the bottom. General refuse and trash were disposed directly into these trenches. Free liquid oil, such as waste engine oil from activity shops, was also disposed in this manner. After a significant volume of material was placed in a trench, the material was ignited and allowed to burn. Proceeding in this manner, the trenches were progressively filled and covered with soil from west to east and north to south (Rogers, Golden & Halpern, 1986).

When the landfill was closed in 1969, a layer of ash from coal-fired power plants at Naval Station Great Lakes was placed over the landfill, and topsoil was placed over the ash. Based on aerial photography, it appears that the front nine-hole portion of the golf course was constructed between 1953 and 1955. The Golf Course Clubhouse, Building 3312, and the parking lot associated with the building were constructed in 1963. The back nine-hole portion of the golf course was initially constructed in 1968 and was reconstructed in 2003 (C.H. Guernsey, 2002).

The FFTU was built on Site 4 in 1942 and operated until it was taken out of service in 1989. The unit was located on 10 acres that are now at the center of the golf course. Consequently, the FFTU was active during the operation of the landfill and during the operation of the golf course. Environmental investigations were conducted to determine the nature and extent of contamination at the FFTU, and environmental remediation of the FFTU was conducted to remove underground and above-ground storage tanks.

E.3 SUMMARY OF REMEDIAL INVESTIGATION

The overall purpose of the RI investigation was to address potential risks associated with the Site and to develop and evaluate options for the remediation of contaminated soil there, following presumptive remedy guidance as encouraged by the United States Environmental Protection Agency (U.S. EPA).

Soil, groundwater, and surface water sampling was conducted at the Site by several contractors over the previous 20 years, as detailed in the Site 1 – Golf Course Landfill Remedial Investigation and Risk Assessment Report (RI/RA) (TtNUS, 2008). In support of the RI/RA, TtNUS conducted investigative activities at Site 1 between December 2006, March 2007, and November 2007. These activities consisted of subsurface soil sampling, installation and sampling of temporary and permanent monitoring wells, aquifer testing of permanent monitoring wells, surface water sampling, and sediment sampling.

In late January and early February 1998, Beling Consultants collected subsurface soil samples from Site 4 – FFTU as part of a Remedial Investigation (RI) (Beling Consultants, 1998a). Subsequently an environmental remediation of the FFTU site was conducted to remove underground and above-ground storage tanks. Additional samples were collected by Beling Consultants on July 13, 1998 in support of the remedial effort and a Corrective Action Completion Report (Beling Consultants, 1998b). On October 22, 1999, TolTest, Inc. collected subsurface soil samples from the former sludge pit as part of the FFTU RI (TolTest Inc., 2000). Samples were collected from various locations and depths within a 130-foot square area and analyzed.

E.4 NATURE AND EXTENT OF CONTAMINATION

The following summarizes the nature and extent of contamination in the Site media:

- The primary source of the Site contamination appears to be the former landfill which occupies approximately 50 acres on the western half of the 125 acre golf course site. Types of waste reportedly disposed at the landfill include domestic refuse, sewage sludge, petroleum, oil, and lubricants, solvents, coal ash, and materials contaminated by PCBs.

- For the RI, 89 soil borings were installed to determine the extent (perimeter) of the landfill based on a decision to consider the entire golf course as the landfill. These 89 borings did not contain waste material based on visual observations and confirmed that the extent of the landfill is within the 125 acre limits of the golf course. However based on review of aerial photographs and historical information it appears that the landfill operations occurred west of Site 4 from 1942 until 1967.

- Volatile organic compounds (VOCs) were detected in subsurface soil, groundwater, and surface water at the site at concentrations less than applicable screening criteria. No VOCs were detected in site sediment samples.

- Polynuclear aromatic hydrocarbons (PAHs) were detected in subsurface soil, groundwater, sediment, and surface water at the site, with many results exceeding screening criteria.

- Pesticides were detected in subsurface soil and sediment samples at the site, with some sample results exceeding screening criteria for ecological receptors.

- Low concentrations of PCBs were detected in several subsurface soil samples and one sediment sample; these concentrations were less than the applicable screening criteria.

- Herbicides were detected in one subsurface soil sample at a concentration less than the applicable screening criteria.

- Several metals were detected in subsurface soil, groundwater, sediment, and surface water samples at concentrations greater than screening criteria. The detected metals include lead, silver, iron, manganese, and thallium.

One of the primary objectives of the RI/RA was to evaluate the nature and extent of the materials disposed at the Site and to determine if the resulting site conditions meet the requirements to continue to pursue the current presumptive remedy strategy. Presumptive remedy guidance is provided in Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (U.S. EPA, 1996) and identifies the waste characteristics of military landfills that allow for the application of the use of streamlined procedures. This guidance states that appropriate waste characteristics include the following:

- Risks are low level, except for “hot spots”
- Treatment of wastes is usually impractical due to the volume and heterogeneity of the waste
- Waste types include household, commercial, non-hazardous sludge, and industrial waste solids
- Lesser quantities of hazardous wastes are present as compared to municipal wastes
- Land application units, surface impoundments, injection wells, and waste piles are not included

The guidance also states that the presumptive remedy relates primarily to containment of landfill mass and collection and/or treatment of landfill gas. It further states that “In addition, measures to control landfill leachate, affected groundwater at the perimeter of the landfill and/or upgradient groundwater that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy” (U.S. EPA, 1993a).

The nature and extent of the materials disposed of at the Site result in site conditions that meet the requirements to continue to pursue the current presumptive remedy strategy.

E.5 BASELINE RISK EVALUATION

Baseline Risk Evaluation was conducted for both Human Health and Ecological Receptors, the results for which are summarized below.

Noncarcinogenic risks (HIs) for subsurface soil, surface water, and sediment were less than U.S. EPA and Illinois EPA benchmarks for the potential receptors evaluated at the Site. Noncarcinogenic risks for potential residential use of groundwater were unacceptable for children and adults. These risks were due to the assumed exposure to maximum detected concentrations of iron, manganese, and vanadium in unfiltered groundwater samples. Risks for lead were acceptable when exposure to average concentrations were assumed but were unacceptable when maximum concentrations were assumed. Carcinogenic risks (ILCRs) for subsurface soil, groundwater, surface water, and sediment were within the U.S. EPA’s target risk range (1x10-6 to 1x10-4) but exceeded the Illinois EPA goal of 1x10-6 for most receptors in these media. Arsenic was the main contributor to risks for groundwater. PAHs and dioxins/furans accounted for most of the risk in the other media.

The following analytes were identified in the Human Health Risk Assessment (HHRA) as chemicals of concern (COCs):

- Subsurface soil – lead and dioxins/furans
- Groundwater – arsenic, iron, lead, manganese, and vanadium

- Surface water – PAHs and dioxins/furans
- Sediment – PAHs and arsenic

Because the Site is covered by a portion of the golf course, there is not a complete exposure pathway for terrestrial receptors. Additionally, contaminant concentrations are low and due to the lack of suitable ecological habitat, the overall risk to ecological receptors is small from the Site contaminants. Therefore, ecological risks were not considered in this FFS.

E.6 REMEDIAL ACTION OBJECTIVES (RAOS)

The RAOs identified in this section are based on the COCs retained for the Site and consist of the following:

RAO 1: Prevent direct contact with landfill contents, therefore eliminating unacceptable human exposure to subsurface soil and landfill contents.

RAO 2: Prevent residential exposure to and consumption of groundwater.

RAO 3: Comply with federal and state applicable or relevant and appropriate requirements (ARARs) and to be considered (TBC) guidance criteria.

RAO 4: Prevent direct exposure routes for human and ecological recipients for the COCs in surface water and sediments.

RAO 5: Minimize subsurface infiltration and resulting contaminant leaching PAHs and dioxins/furans to groundwater and surface water.

E.7 SCREENING OF GENERAL RESPONSE ACTIONS, REMEDIATION TECHNOLOGIES, AND PROCESS OPTIONS

General Response Actions (GRAs) describe categories of actions that could be implemented to satisfy or address a component of an RAO for the site. Remedial action alternatives were composed using GRAs individually, or in combination, that are capable of achieving the RAOs for contaminated media at the Site. The following GRAs were considered for the Site:

- No Action – no direct action to be taken to remediate the landfill

- Institutional Controls – Land Use Controls (LUCs) prohibiting residential land use, groundwater use, and intrusive activities

- Monitoring of natural attenuation and off-site migration

- Containment –soil cover to eliminate exposure pathways, along with surface water and sediment protection

- Removal

E.8 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Based on the technology screening and taking into consideration the presumptive remedy guidance, the following two remedial alternatives were developed for the Site:

- Alternative 1: No Action
- Alternative 2: Containment, Institutional Controls, and Monitoring

E.9 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were analyzed in detail using the nine criteria provided in the U.S. EPA's National Oil and Hazardous Substance Pollution Contingency Plan (NCP) and the CERCLA.

E.10 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were compared to each other using the same nine criteria that were used for detailed analysis. The following is a summary of these comparisons:

E.11 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 would not provide for protection of human health and the environment. The potential for exposure of human receptors to contaminated subsurface soil, landfill contents, and groundwater would increase over time because the existing soil cover would not be maintained and no site-specific institutional controls would be implemented. Also, exposure to COC's in surface water and sediments are not addressed under this alternative. Because no monitoring would occur, no warning would be provided if concentrations of contaminants were to migrate off site.

Of the two, Alternative 2 would provide the higher level of protection because the existing soil cover would be maintained to prevent exposure to impacted subsurface soil and landfill contents and provisions would be made to prevent surface water and sediment exposure. Institutional controls would be implemented to prevent the use of site groundwater, to protect site workers, and restrict residential land use. In addition, the monitoring component of Alternative 2 would provide indication of potential future migration of COCs.

E.12 COMPLIANCE WITH ARARS AND TBCS

Alternative 1 would not comply with chemical-specific ARARs or TBCs because no action would be taken to reduce COC concentrations. Action-specific ARARs or TBCs are not applicable. Alternative 2 would comply with chemical-, location-, and action-specific ARARs and TBCs because it will minimize or restrict exposure to COCs. Alternative 2 would not comply with chemical-specific ARARs in the short-term, but long-term compliance could be achieved through natural attenuation.

E.13 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 would have no long-term effectiveness and permanence because nothing would be done to reduce concentrations of site COCs.

Although no treatment would be used to reduce COC concentrations in the contaminated site media, these media would be effectively contained to limit exposure to human receptors. Alternative 2 would therefore provide long-term effectiveness and permanence. The monitoring component of Alternative 2 would be a means to assess the effectiveness of natural attenuation processes and to verify that COCs are not migrating from the capped area.

E.14 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Alternative 2 would reduce the mobility of COCs by reducing surface water infiltration because maintenance of the cover would increase evapotranspiration. Monitoring would be performed to detect reductions in the toxicity and/or volume of COCs that may occur through natural attenuation.

E.15 SHORT-TERM EFFECTIVENESS

Because no action would occur, implementation of Alternative 1 would not pose risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative 1 would not achieve the RAOs.

Alternative 2 would be effective in the short-term. Implementation of this alternative would not adversely impact the surrounding community or the environment. Because it helps minimize or restrict exposure it is estimated that Alternative 2 would achieve the RAOs upon implementation of the institutional controls and a soil cover maintenance plan.

E.16 IMPLEMENTABILITY

Alternative 1 would be easy to implement because no action would be taken.

Alternative 2 would be readily implementable. Continued maintenance of the existing cover, implementation of institutional controls, and sampling and analysis of site surface water and groundwater could readily be accomplished. The resources, equipment, and materials required to implement these activities are currently available.

The administrative aspects of Alternative 2 would be relatively simple to implement. No construction permits would be required for this alternative. Deed restrictions would ensure continued implementation of institutional controls in the event there is a change in property ownership.

E.17 COST

The capital and operation and maintenance (O&M) costs and net present worth (NPW) of the remedial alternatives were estimated to be as follows:

Alternative	Capital ($)	NPW of O&M ($)	NPW ($)
1	0	0	0
2	1,612,000	621,000 (30-year)	2,233,000 (30-year)

1.0 INTRODUCTION

This Focused Feasibility Study (FFS) Report was prepared for Sites 1 and 4 (Site), Golf Course Landfill (aka Willow Glen Golf Course) and the Fire Fighting Training Unit (FFTU), respectively, at the United States (U.S.) Naval Station Great Lakes located in Lake County, Illinois, under Contract Task Order 506. This FFS was prepared in accordance with the Comprehensive Long-Term Environmental Action Navy IV, Contract Number N62467-04-D-0055, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and its governing regulations, Guidance for Conducting Remedial Investigations and Feasibility Studies [U.S. Environmental Protection Agency (U.S. EPA), 1988], the Superfund Amendments and Reauthorization Act of 1986 and its governing regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, and the National Environmental Policy Act (NEPA) (40 CFR 1500 1508). Also, the presumptive remedy for CERCLA military landfills with municipal landfill waste characteristics, as described by U.S. EPA in Directive 9355.0-049FS, Presumptive Remedy for CERCLA Municipal Landfill Sites, (U.S. EPA, 1993a) and directive 9355.0-67FS, Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (U.S. EPA, 1996), was determined to be appropriate for this site.

The Navy conducted this FFS with a team including representatives from the Illinois Environmental Protection Agency (Illinois EPA), Naval Facilities Engineering Command Midwest (NAVFAC), and the Navy's consultant Tetra Tech NUS, Inc. (TtNUS). The Statement of Work associated with the FFS required identification of possible remedial alternatives to address the risks at the Site. The selected remedy will be determined based on evaluation of the developed alternatives compared to the nine remedy selection criteria outlined in Section 300.430(e) of the NCP and CERCLA Section 121.

1.1 FACILITY BACKGROUND

Naval Station Great Lakes (see Figure 1-1) covers 1,632 acres of Lake County, Illinois. Lake County is located in northeastern Illinois, north of the City of Chicago, and comprises 24 miles of Lake Michigan shoreline. Lake County extends from the Wisconsin border south to Cook County and from Lake Michigan west to McHenry County. Lake County is divided into 18 townships, 52 incorporated cities and villages, and 18 unincorporated cities and villages.

Naval Station Great Lakes administers base operations and provides facilities and related support to training activities (including the Navy's only boot camp), and a variety of other military commands are located on base. A variety of land uses currently surround Naval Station Great Lakes. Along the northern boundary of the base are the most highly urbanized and industrial areas. Much of the land beyond the northwestern site boundary comprises unincorporated lands of Lake County and lies vacant except for scattered retail and residential properties. Adjacent to the western boundary are primarily industrial properties, and along the southern boundary is a mixture of public open space and residential land (TtNUS, 2003).

1.2 SITE CHARACTERIZATION

1.2.1 Location and Description

The Site offers recreational activities for Naval Station Great Lakes and the surrounding area and is located north of Buckley Road and east of Route 41 in the northwestern corner of the naval station (see Figure 1-2). The 18-hole golf course covers approximately 125 acres. A landfill was operated at this site between 1942 and 1967 on approximately 50 acres that is now covered by the western part (back nine) of the golf course. The approximate location of the landfill, as shown on Figure 1-2, has been identified through review of historic aerial photographs, current and historic maps, and interview transcripts with past Naval Station personnel. Information supporting this determination is provided in Appendix A.

Most of the surface and shallow groundwater at the Site drains to the Skokie Ditch, which is a perennial stream that originates somewhere northwest of the Site and travels via an underground storm sewer until it surfaces in the middle of the Site. The Skokie Ditch flows in a southerly direction from the Site, passing the Supply Side area of the base and exiting Navy property after passing the Green Bay Sewage Treatment Plant in Forrestal Village. From there, the Skokie Ditch becomes the Skokie River, which eventually discharges into the Chicago River. The Skokie Ditch is a sluggish and almost stagnant stream in this area, except immediately after storms.

1.2.2 History

Site 1 was a landfill that operated between 1942 and 1967 as a trench/burn facility. It received an estimated 1.5 million tons of material total during its years of operation. Types of waste reportedly disposed at the landfill included domestic refuse, sewage sludge, petroleum, oil, and lubricants, solvents, coal ash, and materials contaminated by polychlorinated biphenyls (PCBs) (C.H. Guernsey, November 2002).

A dragline was used for excavation of the trenches. Each trench was approximately 8 feet wide and was dug to at least the top of the water table [reportedly 6 to 8 feet below ground surface (bgs) in this area]. Occasionally, the trenches had several feet of standing water in the bottom. General refuse and trash were disposed directly into these trenches. Free liquid oil, such as waste engine oil from activity shops, was also disposed in this manner. After a significant volume of material was placed in a trench, the material was ignited and allowed to burn. Proceeding in this manner, the trenches were progressively filled and covered with soil from west to east and north to south (Rogers, Golden & Halpern, 1986).

When the landfill was closed in 1969, a layer of ash from coal-fired power plants at Naval Station Great Lakes was placed over the landfill, and topsoil was placed over the ash. Based on aerial photography, it appears that the front nine-hole portion of the golf course was constructed between 1953 and 1955. The Golf Course Clubhouse, Building 3312, and the parking lot associated with the building were constructed in 1963. The back nine-hole portion of the golf course was initially constructed in 1968 and was reconstructed in 2003 (C.H. Guernsey, 2002).

The FFTU was built on Site 4 in 1942 and operated until it was taken out of service in 1989. The unit was located on 10 acres that are now at the center of the golf course. Consequently, the FFTU was active during the operation of the landfill and during the operation of the golf course. Environmental investigations were conducted to determine the nature and extent of contamination at the FFTU, and environmental remediation of the FFTU was conducted to remove underground and above-ground storage tanks.

Aerial photographs indicate that a trap shooting range operated at the Site after 1953 to sometime between 1964 and 1972. The trap shooting range was located at the end of the current practice driving range, southwest of the golf course maintenance building, with the northern end of the trap shooting range west of the golf course maintenance building. This area was converted to the back nine-hole portion of the Willow Glen Golf Course in 1968 and was reconstructed in 2003 by adding fill to many areas.

In 2003, sinkholes occurred on the Site that were attributed to the collapse of an underground storm sewer pipe that conveys the Skokie Ditch under a portion of the Site. Sinkhole and pipe repair work was performed in October 2003, during which it was determined that the existing storm sewer was in a deteriorated condition. Although the Navy does not have design documents for the storm sewer, it was determined during the repair work that the failed portion of the system is comprised of clay pipe that was installed without gravel/stone bedding. Additional collapses may cause upgradient stormwater to saturate the landfill mass or cause waste materials from the landfill and/or groundwater to enter the Skokie Ditch. Both the Navy and the Skokie Drainage District are committed to addressing damage to the Skokie Ditch infrastructure through repair or replacement. A Technical Memorandum that evaluates potential solutions to this matter is provided in Appendix B. It is intended that the recommended solution be incorporated into this FFS as part of the remedy which is discussed later in this report.

1.2.3 Previous Investigations

Soil, groundwater, and surface water sampling was conducted at the Site by several contractors over the previous 20 years, as detailed in Section 2.3 of the Site 1 – Golf Course Landfill Remedial Investigation and Risk Assessment Report (RI/RA) (TtNUS, 2008). In support of the RI/RA, TtNUS conducted investigative activities at Site 1 during December 2006, March 2007, and November 2007. These activities consisted of subsurface soil sampling, installation and sampling of temporary and permanent monitoring wells, aquifer testing of permanent monitoring wells, and surface water, and sediment sampling. The results of these investigative activities, including a summary of the analytical results, descriptive statistics, and criteria comparisons, are provided in Section 4.0 of the RI/RA.

In late January and early February 1998, Beling Consultants collected subsurface soil samples from Site 4 – FFTU as part of a Remedial Investigation (RI) (Beling Consultants, 1998a). Subsequently an environmental remediation of the FFTU site was conducted to remove underground and above-ground storage tanks. Additional samples were collected by Beling Consultants on July 13, 1998 in support of the remedial effort and a Corrective Action Completion Report (Beling Consultants, 1998b). On October 22, 1999, TolTest, Inc. collected subsurface soil samples from the former sludge pit as part of the FFTU RI (TolTest Inc., 2000). Samples were collected from various locations and depths within a 130-foot square area and analyzed.

The Site 1 RI/RA is representative of conditions at both Site 1 and Site 4. It provides a summary of the analytical results for the samples collected as part of the FFTU RI and Corrective Action Completion Report. Additionally, based on the RI/RA results, it was recommended that an FFS be prepared for the Site. The RI/RA indicated that active remedial actions are unlikely to be required, and the alternatives evaluated in the FFS should include the presumptive remedy for landfills. In general, the presumptive remedy would include maintaining the existing surface cover (golf course), establishing a perimeter groundwater monitoring protocol, and establishing institutional controls to govern future use of site land and groundwater.

1.2.4 Site-Specific Geology and Hydrogeology

1.2.4.1 Geology

Geologic conditions at the Site were characterized as part of the RI/RA. Surface and subsurface materials at the Site were characterized based on acetate liner samples collected during the installation of soil and well borings during the TtNUS field investigation.

The shallow subsurface lithology of the Site consists predominantly of brown silty clay grading to blue-gray clay with infrequent sand and gravel layers to a depth of 40 feet bgs. Along the western portion of the site (nearly the entire north-south-trending western boundary and up to 400 feet along the northern boundary), a thin layer of ash/burn material was observed. The ash/burn material, which was used as cover material during closure of the landfill and as common fill in many areas of the course, is composed of black sands, metal fragments, and coke-like by-products (cinders, manganese nodules ranging from 0.5 to 4 millimeters in diameter and low-density and highly porous rock fragments). The thickness of the ash/burn layer varied significantly from boring to boring but is generally less than 0.5 foot thick. Landfill waste was observed in the interior western portion of the site, and was markedly different than the ash/burn material, being composed of black sands intermixed with significant metal, plastic, glass, and wood. No coke-like burned by-products were observed in the landfill waste. Where waste materials were encountered in the borings, they were found to be covered with a minimum of 2 feet and on average 6.5 feet of soil. Logs of borings in which waste was encountered are provided in Appendix C. Aside from the thin layers of ash/burn material, the cover consisted predominately of low-permeability brown silty clay.

Laboratory sieve analysis of composite samples from the soil deposits indicates that the Unified Soil Classification System descriptions range from ML (sandy silt) to CL (silty clay).

1.2.4.2 Hydrogeology

The Site shallow water table aquifer was characterized as part of the RI/RA. A deeper (confined) aquifer is most likely present (based on previous studies at this site and adjacent areas) but was not part of this investigation. The shallow aquifer ranges from 0.5 to 40 feet bgs and is composed primarily of unconsolidated silty clays to clays and minor silts with discontinuous sand and gravel lenses interspersed throughout. In general, the water table within these heterogeneous deposits is shallow and was typically encountered during the investigation at depths ranging from 1 to 17 feet bgs. Groundwater can be expected to migrate laterally through the more permeable materials within the silty clays and clays. At many soil boring locations, including locations reaching 40 feet bgs, no water was encountered even when sand and gravel lenses were encountered. Additionally, many soil borings did not contain sand and gravel lenses and were subsequently dry. Therefore, the shallow water table aquifer is assumed to be discontinuous across the site.

Groundwater flow directions for the shallow aquifer were determined based on the synoptic water level measurements collected as part of the RI/RA field activities. Groundwater elevations were determined based on these depths to water measurements, then posted on site maps and evaluated. Based on these evaluations, shallow groundwater flows from the north, west, and east toward the Skokie Ditch, which trends north-south in the western portion of the site.

Horizontal hydraulic conductivity (K) values for the shallow aquifer ranged from 0.05 foot per day (1.73×10^{-5} centimeters per second) to 5.13 feet per day (1.81×10^{-3} centimeters per second). The geometric mean of horizontal K values was calculated to be 1.04 feet per day (3.68×10^{-4} centimeters per second). These values are within the typical range for silty clays, clays, and sand and gravel lenses within these formations (Fetter, 1980 and Freeze and Cherry, 1979).

The horizontal hydraulic gradient for the shallow aquifer ranged from approximately 0.021 to 0.0083. Using an average porosity of 0.35 for the gravelly clay/silty clay (Freeze and Cherry, 1979) and the site-wide geometric mean K value of 1.04 feet per day, the site groundwater velocity was determined to be within the range of 0.062 feet per day (22.8 feet per year) and 0.025 feet per day (9 feet per year).

Care must be taken when interpreting these results because significant groundwater flow potential is likely limited to the sand and gravel lenses. There is no evidence from the boring logs that any of these lenses are laterally extensive. Large-scale, site-wide transport of potential contaminants in the shallow aquifer is not likely to be occurring.

1.3 ENVIRONMENTAL CONDITIONS

The following briefly reviews the RI/RA, which characterized conditions at the Site as of November 2007. More detailed information is available in Sections 4.0, 6.0, and 7.0 of the RI/RA. In this section, the environmental conditions, including the nature and extent of contamination and human health and ecological risk assessment results, are briefly reviewed.

1.3.1 <u>Nature and Extent of Contamination</u>

The following summarizes the nature and extent of contamination in the Site media:

- The primary source of the Site contamination appears to be the former landfill which occupies 50 acres of the western half of 125 acre golf course site. Types of waste reportedly disposed at the landfill include domestic refuse, sewage sludge, petroleum, oil, and lubricants, solvents, coal ash, and materials contaminated by PCBs.

- For the RI, 89 soil borings were installed to determine the extent (perimeter) of the landfill based on a decision to consider the entire golf course as the landfill. These 89 borings did not contain waste material based on visual observations and confirmed that the extent of the landfill is within the 125 acre limits of the golf course. However based on review of aerial photographs and historical information it appears that the landfill operations occurred west of Site 4 from 1942 until 1967. The landfill and FFTU operations affect approximately 50 acres of the golf course (back nine).

- Volatile organic compounds (VOCs) were detected in subsurface soil, groundwater, and surface water at the site at concentrations less than applicable screening criteria. No VOCs were detected in site sediment samples.

- Polynuclear aromatic hydrocarbons (PAHs) were detected in subsurface soil, groundwater, sediment, and surface water at the site, with many results exceeding screening criteria.

- Pesticides were detected in subsurface soil and sediment samples at the site, with some sample results exceeding screening criteria for ecological receptors.

- Low concentrations of PCBs were detected in several subsurface soil samples and one sediment sample; these concentrations were less than the applicable screening criteria.

- Herbicides were detected in one subsurface soil sample at a concentration less than the applicable screening criteria.

- Several metals were detected in subsurface soil, groundwater, sediment, and surface water samples at concentrations greater than screening criteria. The detected metals include lead, silver, iron, manganese, and thallium.

1.3.2 Human Health Risk Assessment

A human health risk assessment (HHRA) was performed for the Site to characterize the potential risks to likely human receptors under current and potential future land use.

Potential receptors under current land use are maintenance workers, adolescent trespassers/recreational users, and adult recreational users. Potential receptors under future land use are construction/excavation workers, occupational workers, and hypothetical child and adult residents. Military residents (child and adult) were evaluated by reference to hypothetical civilian residents. Although the site is not likely to be developed for residential use, potential future residential receptors were evaluated in the HHRA primarily for decision making purposes.

The direct contact chemicals of potential concern (COPCs) retained for quantitative risk evaluation at the Site are as follows:

- Subsurface soil – benzo(a)anthracene, BaP, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, dioxins/furans, aluminum, antimony, arsenic, chromium, copper, iron, lead, manganese, silver, thallium, vanadium

- Groundwater – benzene, naphthalene, 2-methylnaphthalene, aluminum, arsenic, barium, chromium, iron, lead, manganese, vanadium

- Surface water – vinyl chloride, BaP, dioxins/furans, antimony, thallium

- Sediment – benzo(a)anthracene, BaP, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3 cd)pyrene, Aroclor-1248, dioxins/furans, aluminum, arsenic, chromium, iron, thallium, vanadium

To evaluate the potential for chemicals detected in soil to impact groundwater, maximum chemical concentrations were compared to USEPA and Illinois EPA Soil Screening Levels (SSLs) for migration to groundwater. Migration-to-Groundwater SSLs were not used for COPC selection because quantitative risk assessments are typically based on direct contact with soil or inhalation of vapors and particulates. There is no methodology available for quantitative risk evaluation of indirect exposure based on migration to groundwater. Therefore, it is not appropriate to select COPCs for quantitative risk evaluation for direct exposure on the basis of the indirect soil-to-groundwater pathway.

The results of the HHRA for the Site are discussed below and are presented in Table 1-1.

Exposure to Subsurface Soil

The cumulative Hazard Index (HI) for the receptor most likely to be exposed to subsurface soil at the Site, the future construction/excavation worker, was less than unity (1.0) on a target organ basis, indicating that adverse noncarcinogenic health effects are not anticipated for this receptor under the defined exposure conditions.

The cumulative Incremental Lifetime Cancer Risk (ILCR) for the construction/excavation worker (ILCR = $5x10^{-6}$) was within the U.S. EPA target risk range of $1x10^{-6}$ to $1x10^{-4}$ but exceeded the Illinois EPA goal of $1x10^{-6}$. Ingestion of dioxins/furans accounted for more than 90 percent of the total subsurface soil ILCR. The construction worker risks were based on the assumption of exposure to the maximum concentrations in subsurface soil.

Exposure to Surface Water in the Skokie Ditch

Risks for surface water were based on maximum detected concentrations. HIs for the potential receptors were less than unity (1.0), indicating that adverse noncarcinogenic health effects are not anticipated for the potential receptors under the defined exposure conditions.

The cumulative ILCR for the construction/excavation worker ($7x10^{-7}$) was less than the U.S. EPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. Cumulative ILCRs for maintenance workers ($1x10^{-5}$), adolescent trespassers/ recreational users ($2x10^{-5}$), adult recreational users ($1x10^{-5}$), and future residents (total residential ILCR = $3x10^{-5}$) were within the U.S. EPA target risk range but exceeded the Illinois EPA goal of $1x10^{-6}$. Dermal contact with PAHs and dioxins/furans was the major contributor to these ILCRs. There are uncertainties in the risk estimates for dermal contact with PAHs and dioxins/furans in surface water that tend to greatly overestimate the risks (see Sections 6.4.4.2 and 6.5.3.3 of the RI/RA).

Exposure to Sediment in the Skokie Ditch

HIs for the potential receptors were less than unity (1.0), indicating that adverse noncarcinogenic health effects are not anticipated for the potential receptors under the defined exposure conditions. Cumulative ILCRs for construction/excavation workers ($3x10^{-7}$) were less than the U.S. EPA target risk range of $1x10^{-6}$ to $1x10^{-4}$. Cumulative ILCRs for maintenance workers ($3x10^{-6}$), adolescent trespassers and recreational users ($3x10^{-6}$), adult recreational users ($2x10^{-6}$), and future residents (total residential ILCR =

7×10^{-6}) were within the U.S. EPA target risk range but exceeded the Illinois EPA goal of 1×10^{-6}. PAHs and arsenic accounted for most of the total ILCRs.

Exposure to Groundwater

The groundwater risks were based on assumed exposure to maximum detected concentrations. The cumulative HI for construction/excavation workers was less than 1 on a target organ basis.

The cumulative groundwater HIs for future child and adult residents (HIs = 33 and 10, respectively) exceeded unity. The major contributors to the HIs were iron [child Hazard Quotient (HQ) = 2, adult HQ = 0.7], manganese (child HQ = 25, adult HQ = 7.5), and vanadium (child HQ = 2, adult HQ = 0.6).

The cumulative ILCR for the construction worker (1×10^{-9}) was less than 1×10^{-6}. The total residential ILCR (child + adult = 9×10^{-5}) was within the U.S. EPA's target risk range but exceeded the Illinois EPA goal of 1×10^{-6}. The residential risks were due to arsenic, which accounted for more than 99 percent of the total ILCR. However, the maximum detected concentration of arsenic [3.3 micrograms per liter (µg/L)] is less than the U.S. EPA Maximum Contaminant Level (MCL) (10 µg/L) and the Illinois EPA Remediation Objective for Class 1 Groundwater (50 µg/L) and is probably within naturally occurring background levels.
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Exposure to Lead

Exposure to lead was evaluated because the maximum detected lead concentration in subsurface soil exceeded USEPA and Illinois EPA screening levels for residential land use and the maximum concentration in groundwater exceeded the Illinois EPA Remediation Objective for Class I Groundwater. Exposure to lead was assessed using USEPA's models. Risks for lead were evaluated for exposure to average concentrations (as recommended by the USEPA) and to maximum concentrations (as recommended by Illinois EPA).

The analysis of lead in subsurface soil and groundwater at the Site indicated that predicted blood levels for children and excavation/construction workers and their fetuses were acceptable when exposed to the average lead concentration but were not acceptable when exposure to the maximum detected concentrations were assumed.

HHRA Summary

In summary, noncarcinogenic risks (HIs) for subsurface soil, surface water, and sediment were less than U.S. EPA and Illinois EPA benchmarks for the potential receptors evaluated at the Site. Noncarcinogenic risks for potential residential use of groundwater were unacceptable for children and adults. These risks were due to the assumed exposure to maximum detected concentrations of iron, manganese, and vanadium in unfiltered groundwater samples. Risks for lead were acceptable when exposure to average concentrations were assumed but were unacceptable when maximum concentrations were assumed.

Carcinogenic risks (ILCRs) for subsurface soil, groundwater, surface water, and sediment were within the U.S. EPA's target risk range ($1x10^{-6}$ to $1x10^{-4}$) but exceeded the Illinois EPA goal of $1x10^{-6}$ for most receptors in these media. Arsenic was the main contributor to risks for groundwater. PAHs and dioxins/furans accounted for most of the risk in the other media.

As discussed in Sections 6.4.4 and 6.5 of the RI/RA, the risk estimates were subject to a number of significant uncertainties. Among these are the facts that background data are not available for groundwater and surface water, concentrations of metals in some groundwater samples appear to be elevated because of suspended matter in the samples, and groundwater is not currently used at the Site nor is it expected to be used in the future. Surface soil was not evaluated in the risk assessment because the Site surface soil consists of clean topsoil that was placed over the landfill during the landfill closure activities and the subsequent construction and re-construction of the golf course.

1.3.3 Ecological Risk Assessment

A Screening-Level Ecological Risk Assessment (SERA) was performed as part of the recent RI/RA at the Site. The goal of the SERA for the Site was to determine whether adverse ecological impacts are possible as a result of exposure to chemicals. The SERA relied on environmental chemistry data; biological sampling or testing was not conducted for the RI/RA. The SERA methodology used at Naval Station Great Lakes followed the guidance presented in the Final Guidelines for Ecological Risk Assessment (U.S. EPA, 1998), Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (U.S. EPA, 1997), Navy Policy for Conducting Ecological Risk Assessments (U.S. Navy, 1999), and the Quality Assurance Project Plan (TtNUS, 2007) prepared for the RI/RA project. The results of the SERA are discussed below and are presented in Section 7.0 of the RI/RA report.

Because the Site is covered by a portion of the golf course, there is not a complete exposure pathway for terrestrial receptors. For that reason, surface soil samples were not collected, and risks to terrestrial ecological receptors were not evaluated in the SERA. Potential ecological receptors (e.g., benthic macroinvertebrates and fish) can be exposed to chemicals in the surface water and sediment of Skokie Ditch by direct contact and incidental ingestion of surface water and surface sediment (0 to 4 centimeters bgs). Also, mammals and birds can be exposed to chemicals in the surface water and surface sediment of Skokie Ditch by direct contact, ingestion of contaminated food items, and incidental ingestion of surface water and surface sediment. Exposure of terrestrial wildlife to chemicals in surface water and surface sediment via dermal contact is unlikely to represent a major exposure pathway because fur and feathers are expected to minimize transfer of chemicals across dermal tissue. Therefore, the dermal pathway was not evaluated in the SERA.

Several chemicals detected in surface water and/or surface sediment were initially retained as ecological COPCs because their chemical concentrations exceeded screening levels or because they were bioaccumulative chemicals with ecological effects quotients (EEQs) greater than 1.0 based on conservative exposure scenarios. These chemicals were then re-evaluated, per Section 7.6 of the RI/RA, to determine which chemicals had the greatest potential for causing risks to ecological receptors and to determine which COPCs should be retained for further discussion/evaluation. The two primary ecological endpoints evaluated were aquatic organisms (i.e., fish and invertebrates) and mammals and birds that consume invertebrates and/or fish. Therefore, different lists of chemicals were retained as COPCs for these different endpoints.

None of the initially selected COPCs for surface sediment or surface water were retained as COPCs for aquatic biota, and none of the initially selected COPCs for piscivorous mammals or birds were retained as COPCs for further evaluation. Therefore, because contaminant concentrations are low and because of the lack of suitable ecological habitat, the overall risk to ecological receptors is small from the Site contaminants. Ecological risks were not considered in this FFS.

1.3.4 Chemicals of Concern

Based on the evaluation of the COPC and results of the HHRA and ERA performed for the RI/RA as stated above, the following chemicals of concern (COCs) were retained for analysis:

- Subsurface soil – lead and dioxins/furans
- Groundwater – arsenic, iron, lead, manganese, and vanadium
- Surface water – PAHs and dioxins/furans

- Sediment – PAHs and arsenic

1.4 PRESUMPTIVE REMEDY

Presumptive remedies are preferred technologies for common categories of sites that are based on U.S. EPA evaluations of performance data on previous technology implementation. By streamlining site investigation and accelerating the remedy selection process, presumptive remedies are expected to ensure the consistent selection of remedial actions and reduce the cost and time required to clean up similar sites. Presumptive remedies are expected to be used at all appropriate sites, except under unusual site-specific circumstances.

As discussed earlier in this section, one of the primary objectives of the RI/RA was to evaluate the nature and extent of the materials disposed of at the Site and to determine if the resulting site conditions meet the requirements to continue to pursue the current presumptive remedy strategy. Presumptive remedy guidance is provided in Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (U.S. EPA, 1996) and identifies the waste characteristics of military landfills that allow for the use of streamlined procedures. This guidance states that appropriate waste characteristics include the following:

- Risks are low level, except for “hot spots”
- Treatment of wastes is usually impractical due to the volume and heterogeneity of the waste
- Waste types include household, commercial, non-hazardous sludge, and industrial waste solids
- Lesser quantities of hazardous wastes are present as compared to municipal wastes
- Land application units, surface impoundments, injection wells, and waste piles are not included

The guidance further states that military landfills are anticipated to have industrial solid waste, paints (and paint thinners), pesticides, transformer oils, and other solvents in relatively low proportion to the volume of municipal wastes including construction debris, commercial/household type garbage, and yard wastes. The types of waste that would exclude a military site from presumptive remedy consideration include chemical warfare agents, munitions, and other explosives.

Also, the guidance states that the presumptive remedy relates primarily to containment of landfill mass and collection and/or treatment of landfill gas. It further states that “In addition, measures to control landfill leachate, affected groundwater at the perimeter of the landfill and/or upgradient groundwater that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy” (U.S. EPA, 1993a).

Based on knowledge of historical landfill operations and the data collected as part of the RI/RA, the Site has the characteristics necessary to apply the presumptive remedy. Additionally, due to the dilapidated condition of the underground Skokie Ditch sewer pipe there is potential for upgradient surface water to saturate the landfill mass and generate leachate. Likewise there is potential for impacted groundwater and/or landfill waste to infiltrate the pipe and discharge to surface water. Because these conditions affect leachate generation and discharge they can and will be addressed as part of the presumptive remedy.

1.5 DOCUMENT ORGANIZATION

This FFS has been organized with the intent of meeting the general format requirements specified in the RI/FS Guidance Document (U.S. EPA, 1988) and consists of the following five sections:

- Section 1.0, Introduction - summarizes the purpose of the report, provides site background information, summarizes findings of the previous investigations, and provides the report outline.

- Section 2.0, Remedial Action Objectives and General Response Actions - presents the Remedial Action Objectives (RAOs), identifies Applicable or Relevant and Appropriate Requirements (ARARs), To Be Considered (TBC) criteria, and General Response Actions (GRAs), and provides an estimate of the volume of contaminated media to be remediated.

- Section 3.0, Screening of Remediation Technologies and Process Options - provides a two-tiered screening of potentially applicable remediation technologies and identifies the technologies that will be assembled into remedial alternatives.

- Section 4.0, Assembly and Detailed Analysis of Remedial Alternatives - assembles the remedial technologies retained from the Section 3.0 screening process into multiple remedial alternatives, describes these alternatives, and performs a detailed analysis of these alternatives in accordance with the nine CERCLA criteria.

- Section 5.0, Comparative Analysis of Remedial Alternatives - compares the remedial alternatives to each other, on a criterion-by-criterion basis, in accordance with the nine CERCLA criteria used in Section 4.0.

TABLE 1-1

SUMMARY OF HUMAN HEALTH RISKS
POTENTIAL CURRENT AND FUTURE LAND USE SCENARIOS
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Construction/Excavation Worker	Subsurface Soil	Ingestion	5.E-06	2	2.E-06	1
		Dermal Contact	6.E-07	0.02	2.E-07	0.007
		Inhalation	2.E-07	0.4	5.E-08	0.12
		Total	5.E-06	2.4	2.E-06	1
	Sediment	Ingestion	2.E-07	0.2	1.E-07	0.1
		Dermal Contact	6.E-08	0.009	2.E-08	0.003
		Total	3.E-07	0.2	1.E-07	0.1
	Surface Water	Ingestion	2.E-09	0.01	8.E-10	0.00
		Dermal Contact	7.E-07	0.02	5.E-07	0.009
		Total	7.E-07	0.03	5.E-07	0.01
	Groundwater	Ingestion	NA	NA	NA	NA
		Dermal Contact	1.E-09	1	6.E-10	0.5
		Inhalation (in a trench)	8.E-11	0.02	2.E-11	0.01
		Total	1.E-09	1	6.E-10	0.5
		Total Subsurface Soil	5.E-06	2	2.E-06	1
		Total Sediment	3.E-07	0.25	1.E-07	0.1
		Total Surface Water	7.E-07	0.03	5.E-07	0.01
		Total Groundwater	1.E-09	1	6.E-10	0.5
		Total Across the Entire Site	**6.E-06**	**4**	**3.E-06**	**2**

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Maintenance Worker	Sediment	Ingestion	2.E-06	0.01	1.E-07	0.003
		Dermal Contact	1.E-06	0.0007	2.E-08	0.00003
		Total	3.E-06	0.01	2.E-07	0.003
	Surface Water	Ingestion	2.E-08	0.002	2.E-09	0.0005
		Dermal Contact	1.E-05	0.001	2.E-06	0.0003
		Total	1.E-05	0.003	2.E-06	0.0007
		Total Sediment	3.E-06	0.01	2.E-07	0.003
		Total Surface Water	1.E-05	0.003	2.E-06	0.0007
		Total Across the Entire Site	**2.E-05**	**0.02**	**2.E-06**	**0.004**

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Adolescent Trespasser / Recreational User	Sediment	Ingestion	2.E-06	0.04	5.E-07	0.01
		Dermal Contact	1.E-06	0.002	1.E-07	0.0002
		Total	3.E-06	0.04	7.E-07	0.01
	Surface Water	Ingestion	5.E-08	0.01	1.E-08	0.003
		Dermal Contact	2.E-05	0.007	8.E-06	0.002
		Total	2.E-05	0.02	8.E-06	0.005
		Total Sediment	3.E-06	0.04	7.E-07	0.01
		Total Surface Water	2.E-05	0.02	8.E-06	0.005
		Total Across the Entire Site	**3.E-05**	**0.06**	**9.E-06**	**0.02**

TABLE 1-1

SUMMARY OF HUMAN HEALTH RISKS
POTENTIAL CURRENT AND FUTURE LAND USE SCENARIOS
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Adult Recreational User	Sediment	Ingestion	2.E-06	0.01	1.E-07	0.003
		Dermal Contact	6.E-07	0.0004	1.E-08	0.00003
		Total	2.E-06	0.01	1.E-07	0.003
	Surface Water	Ingestion	9.E-09	0.001	1.E-09	0.0005
		Dermal Contact	1.E-05	0.001	2.E-06	0.0004
		Total	1.E-05	0.002	2.E-06	0.0009
		Total Sediment	2.E-06	0.01	1.E-07	0.003
		Total Surface Water	1.E-05	0.002	2.E-06	0.0009
		Total Across the Entire Site	**2.E-05**	**0.01**	**2.E-06**	**0.004**

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Future Child Resident	Sediment	Ingestion	4.E-06	0.1	3.E-07	0.03
		Dermal Contact	9.E-07	0.003	3.E-08	0.0003
		Total	5.E-06	0.1	3.E-07	0.03
	Surface Water	Ingestion	1.E-07	0.04	1.E-08	0.01
		Dermal Contact	1.E-05	0.005	2.E-06	0.001
		Total	1.E-05	0.05	2.E-06	0.01
	Groundwater	Ingestion	4.E-05	31	4.E-06	9
		Dermal Contact	7.E-08	1.1	1.E-08	0.6
		Inhalation (showering)	4.E-08	0.2	5.E-09	0.07
		Total	4.E-05	33	4.E-06	10
		Total Sediment	5.E-06	0.1	3.E-07	0.03
		Total Surface Water	1.E-05	0.05	2.E-06	0.01
		Total Groundwater	4.E-05	33	4.E-06	10
		Total Across the Entire Site	**6.E-05**	**33**	**6.E-06**	**10**

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Future Adult Resident	Sediment	Ingestion	2.E-06	0.01	1.E-07	0.003
		Dermal Contact	6.E-07	0.0004	1.E-08	0.00003
		Total	2.E-06	0.01	1.E-07	0.003
	Surface Water	Ingestion	2.E-08	0.002	1.E-09	0.0005
		Dermal Contact	2.E-05	0.002	2.E-06	0.0004
		Total	2.E-05	0.004	2.E-06	0.0009
	Groundwater	Ingestion	5.E-05	9	6.E-06	4
		Dermal Contact	2.E-07	0.6	2.E-08	0.3
		Inhalation (showering)	3.E-08	0.04	3.E-09	0.02
		Total	5.E-05	10	6.E-06	5
		Total Sediment	2.E-06	0.01	1.E-07	0.003
		Total Surface Water	2.E-05	0.004	2.E-06	0.0009
		Total Groundwater	5.E-05	10	6.E-06	5
		Total Across the Entire Site	**7.E-05**	**10**	**9.E-06**	**5**

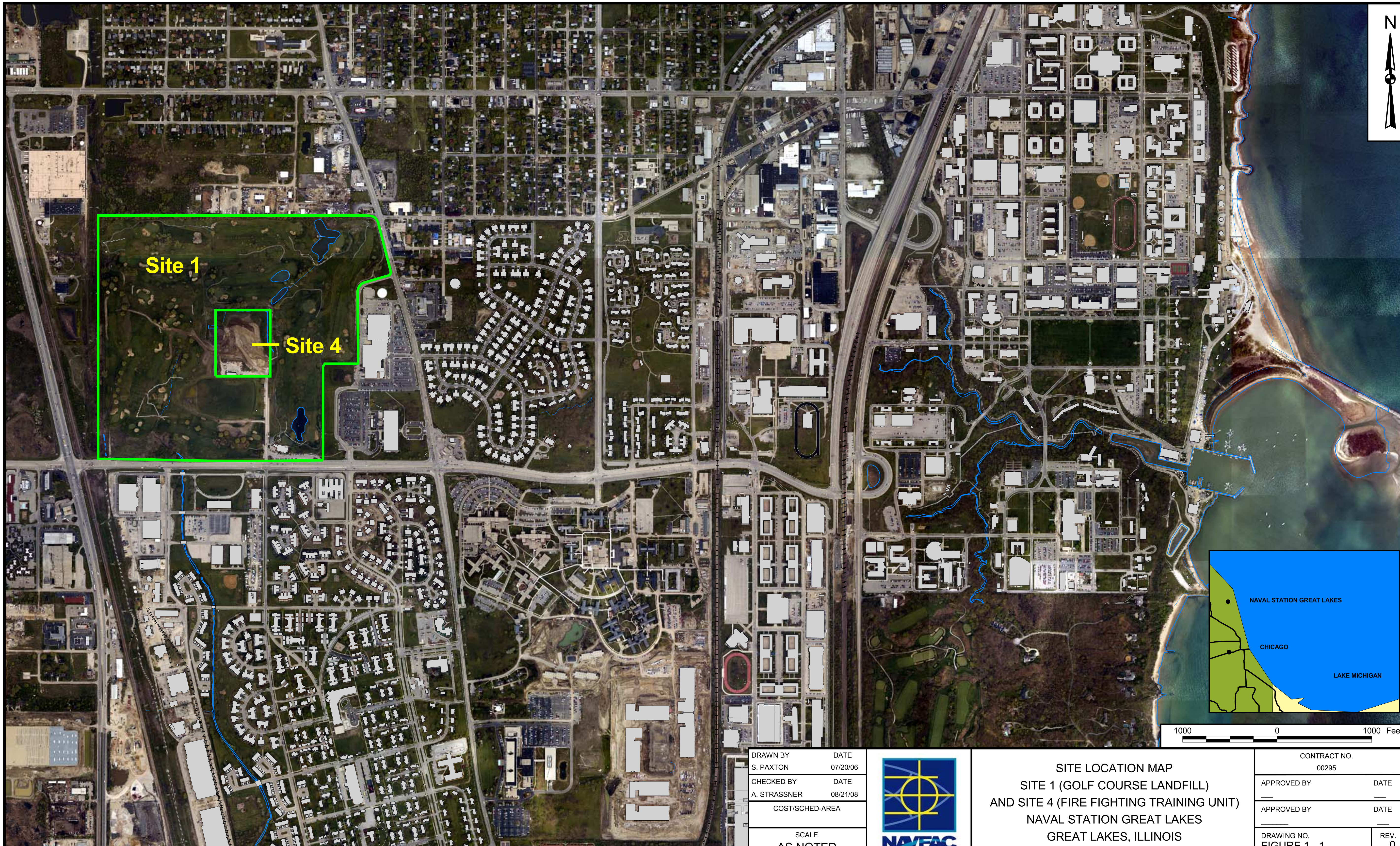
TABLE 1-1

SUMMARY OF HUMAN HEALTH RISKS
POTENTIAL CURRENT AND FUTURE LAND USE SCENARIOS
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Receptor	Medium	Exposure Route	RME		CTE	
			Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Total Residential Risks	Sediment	Ingestion	5.E-06	NA	4.E-07	NA
		Dermal Contact	1.E-06	NA	4.E-08	NA
		Total	7.E-06	NA	5.E-07	NA
	Surface Water	Ingestion	1.E-07	NA	1.E-08	NA
		Dermal Contact	3.E-05	NA	4.E-06	NA
		Total	3.E-05	NA	4.E-06	NA
	Groundwater	Ingestion	9.E-05	NA	1.E-05	NA
		Dermal Contact	2.E-07	NA	4.E-08	NA
		Inhalation (showering)	7.E-08	NA	8.E-09	NA
		Total	9.E-05	NA	1.E-05	NA
		Total Sediment	7.E-06	NA	5.E-07	NA
		Total Surface Water	3.E-05	NA	4.E-06	NA
		Total Groundwater	9.E-05	NA	1.E-05	NA
		Total Across the Entire Site	**1.E-04**	**NA**	**1.E-05**	**NA**

RME = Reasonable Maximum Exposure.
CTE = Central Tendency Exposure.
NA = Not Applicable.
Shaded cells indicate an exceedance of target risk levels .

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE1.APR SITE LOCATION MAP LAYOUT 08/21/08 JEE



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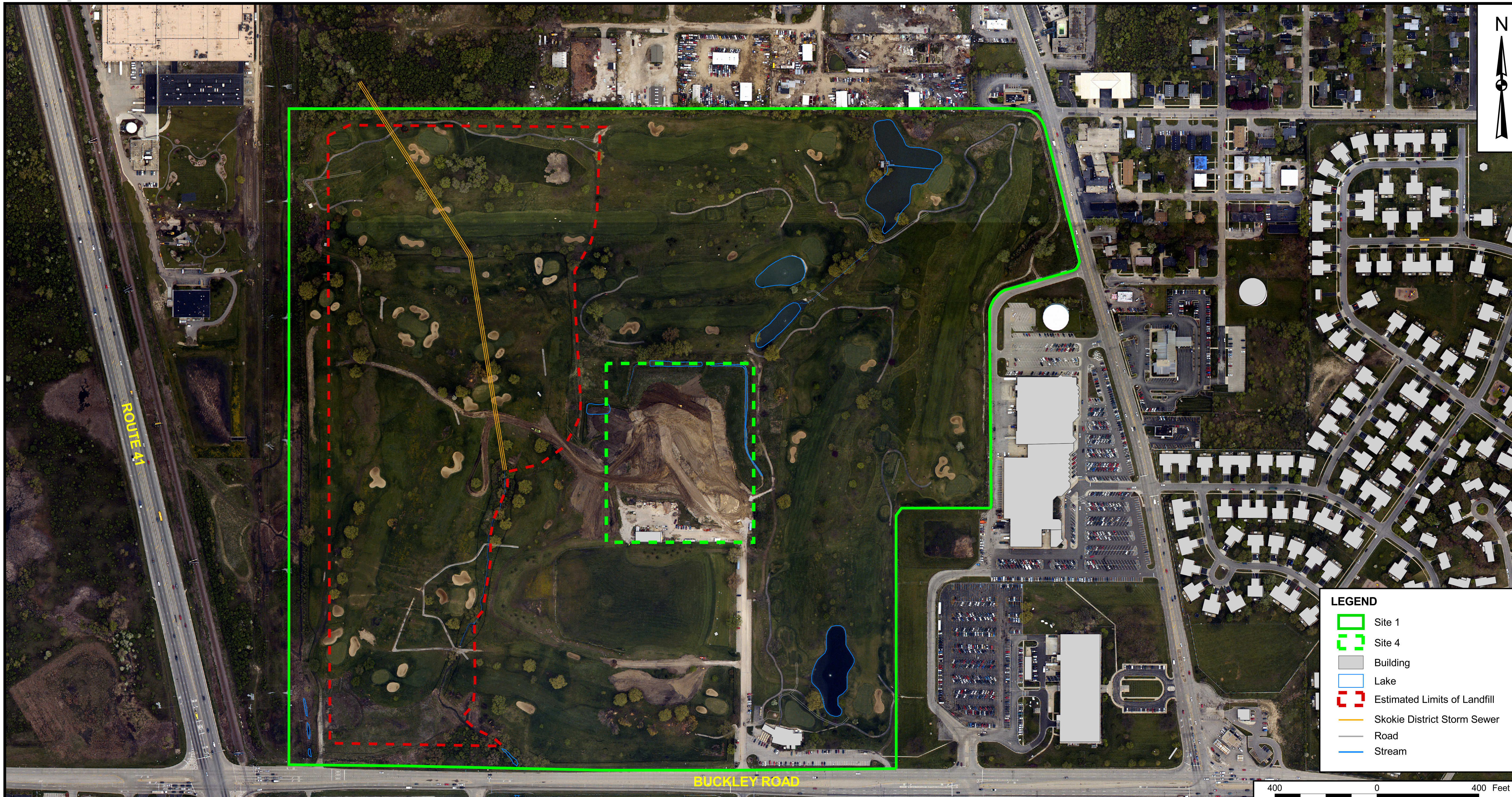
CHECKED BY A. STRASSNER	DATE 08/21/08			APPROVED BY — DATE —
COST/SCHED-AREA				APPROVED BY — DATE —
SCALE AS NOTED				DRAWING NO. FIGURE 1 - 1	REV. 0

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE1.APR SITE MAP LAYOUT 12/17/08 KM



DRAWN BY S. PAXTON	DATE 07/20/06	SITE MAP SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NO. 00078
CHECKED BY B. CUMMINGS	DATE 12/17/08		APPROVED BY / DATE
COST/SCHED-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1 - 2 / REV. 0

NAVFAC

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section presents the RAOs for the Site. The objectives and goals for the remedial action at the Site provide the basis for selecting RAOs and identifying remedy technologies to address unacceptable exposure scenarios that may be encountered. In September 1993, U.S. EPA established source containment and groundwater monitoring as the presumptive remedy for municipal landfill sites regulated under CERCLA. The remedy for the Site would be containment via maintenance of the existing soil cover, deployment of institutional controls, and groundwater monitoring. Additional measures such as repair of the Skokie Ditch infrastructure will also be considered as part of the presumptive remedy.

This section also presents GRAs for contaminated media at the Site. GRAs are categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Lastly, this section provides an estimate of the area and volume of contaminated media to be addressed at the Site.

Containment is the presumptive remedy for military landfills with municipal landfill waste characteristics. Application of the presumptive remedy approach has been discussed, and data collected during the RI/RA process support its use as an alternative for the Site. Use of the presumptive remedy eliminates the need for the initial identification and screening of alternatives during the FFS because the U.S. EPA has found that certain technologies are appropriately rejected on the basis of effectiveness, feasibility, or cost.

2.1 REMEDIAL ACTION OBJECTIVES

The purpose of this section is to develop RAOs for the Site at Naval Station Great Lakes, Illinois. Development of RAOs is an important step in the FFS process. The RAOs are medium-specific goals that define the objectives of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable ranges of contaminant concentrations [i.e., preliminary remediation goals (PRGs)] for the site. Section 2.1.1 presents the RAOs developed for the Site.

The development of PRGs takes into consideration ARARs and TBCs. Section 2.1.2 identifies the ARARs and TBCs, Section 2.1.3 identifies the media of concern, and Section 2.1.4 identifies the COCs for remediation.

2.1.1 Statement of Remedial Action Objectives

RAOs are the medium-specific goals established to protect human health and the environment. U.S. EPA guidance documents for the presumptive remedy provide typical primary RAOs, which include:

- Preventing direct contact with landfill contents.
- Minimizing infiltration and resulting contaminant leaching to groundwater.
- Controlling surface water run-off and erosion.
- Collecting and treating contaminated groundwater and leachate to contain the contaminant plume and prevent further migration from the source area.
- Controlling and treating landfill gas.

Also, the guidance mentioned above lists RAOs for Non-Presumptive Remedy Components:

- Remediating groundwater.
- Remediating contaminated surface water and sediments.
- Remediating contaminated wetland areas

Taking the referenced documents into consideration and evaluating the information from previous investigations and COCs retained, the RAOs for the Site consist of the following:

RAO 1: Prevent direct contact with landfill contents, therefore eliminating unacceptable human exposure to subsurface soil and landfill contents.

RAO 2: Prevent residential exposure to and consumption of groundwater.

RAO 3: Comply with federal and state ARARs and TBC guidance criteria.

RAO 4: Preventing direct exposure routes for human and ecological recipients for the COCs in surface water and sediments.

RAO 5: Minimizing subsurface infiltration and resulting contaminant leaching PAHs and dioxins/furans to groundwater and surface water.

In meeting these RAOs, contaminated media containing listed hazardous waste may be left in place.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

ARARs consist of the following:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation.

TBCs are nonpromulgated, nonenforceable guidelines or criteria that may be useful for developing a remedial action or that are necessary for determining what is protective to human health and/or the environment. Examples of TBCs include U.S. EPA’s Drinking Water Health Advisories, Reference Doses (RfDs), and Cancer Slope Factors (CSFs).

One of the primary concerns during the development of remedial action alternatives for hazardous waste sites under CERCLA is the degree of human health and environmental protection offered by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements.

2.1.2.1 Definitions

The definitions of ARARs are as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law. Although relevant and appropriate requirements are not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, they address problems or situations sufficiently similar to those encountered at a CERCLA site, making their use well suited for CERCLA sites.

- TBCs are a category created by U.S. EPA that includes nonpromulgated criteria, advisories, and guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. However, pertinent TBCs will be considered along with ARARs in determining the necessary level of cleanup or technology requirements.

Under CERCLA Section 121(d)(4), U.S. EPA may waive compliance with an ARAR if one of the following conditions can be demonstrated:

- The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control upon completion.

- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.

- Compliance with the requirement is technically impracticable from an engineering perspective.

- The remedial action selected will attain a standard of performance that is equivalent to that required by the ARAR through the use of another method or approach.

- With respect to a state requirement, the state has not consistently applied the ARAR in similar circumstances at other remedial actions within the state.

The NCP identifies three categories of ARARs [40 CFR Section 300.400 (g)] as follows:

- <u>Chemical-Specific</u>: Health risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include U.S. EPA MCLs and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQCs).

- <u>Location-Specific</u>: Restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of these areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

- <u>Action-Specific</u>: Include technology- or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include wastewater discharge standards, performance/design standards, control standards, and restrictions on particular types of activities.

Chemical- and location-specific ARARs and TBCs are discussed in this section. Action-specific ARARs and TBCs are presented in Section 2.3, along with the discussion of GRAs.

2.1.2.2 Chemical-Specific ARARs and TBCs

Table 2-1 presents federal and State of Illinois chemical-specific ARARs and TBCs applicable to this FFS. The chemical-specific ARARs and TBCs provide some medium-specific guidance on “acceptable” or “permissible” concentrations of contaminants.

2.1.2.3 Location-Specific ARARs and TBCs

Table 2-2 presents federal and State of Illinois location-specific ARARs and TBCs for this FFS. The location-specific ARARs and TBCs place restrictions on concentrations of contaminants or the conduct of activities solely based on the site’s particular characteristics or location.

2.1.3 <u>Media of Concern</u>

The investigation of the Site consisted of evaluating potential human and ecological risks from chemicals in groundwater, surface water, subsurface soil, and sediment. Based on the results of the risk assessment, the above-mentioned media were determined to be of concern at the Site.

2.1.4 <u>Chemicals of Concern for Remediation</u>

Human health COCs for the Site were established based on the results of the HHRA performed for the RI/RA. The results of the risk assessment indicated that noncarcinogenic risks (i.e., HIs) for subsurface soil, surface water, and sediment were less than U.S. EPA and Illinois EPA benchmarks for the potential receptors evaluated at the Site. Noncarcinogenic risks exceeded criteria for naphthalene and benzene for potential residential use of groundwater by children and adults due to the assumed exposure to maximum detected concentrations of iron, manganese, and vanadium in unfiltered groundwater samples.

Carcinogenic risks (i.e., ILCRs) for subsurface soil, groundwater, surface water, and sediment were within U.S. EPA’s target risk range ($1x10^{-6}$ to $1x10^{-4}$) but exceeded the Illinois EPA goal of $1x10^{-6}$ for most receptors in these media. Based on calculated risks, the following COCs were established:

- Subsurface soil – lead and dioxins/furans
- Groundwater – arsenic, iron, lead, manganese, and vanadium
- Surface water – PAHs and dioxins/furans
- Sediment – PAHs and arsenic

Additional details on COC identification are available in Section 6.4 of the RI/RA.

2.2 GENERAL RESPONSE ACTIONS AND ACTION-SPECIFIC ARARS

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with one or more others) to attain the RAOs. Action-specific ARARs and TBCs are those regulations, criteria, and guidances that must be complied with or taken into consideration during on-site remedial activities.

2.2.1 General Response Actions

GRAs describe categories of actions that could be implemented to satisfy or address a component of an RAO for the site. Remedial action alternatives were then composed using GRAs individually or in combination to meet the RAOs. The following GRAs were considered for the Site:

- No Action –no direct action to be taken to remediate the landfill

- Institutional Controls – Land Use Controls (LUCs) prohibiting residential land use, groundwater use, and intrusive activities.

- Monitoring of natural attenuation and off-site migration

- Containment – such as a soil cover to eliminate exposure pathways along with surface water and sediment protection

- Removal

2.2.2 Action-Specific ARARs

Action-specific ARARs and TBCs are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Table 2-3 presents federal and State of Illinois action-specific ARARs and TBCs for this FFS.

2.3 ESTIMATED LANDFILL AREA AND VOLUME

Based on historical records and information, it is estimated that the landfill once operated within Site 1 covers approximately 50 acres and that 1.5 million tons of waste were disposed there by a trench-and-fill operation, typically accompanied by incineration prior to backfilling. The waste is presumed to be present below a minimum of 2 feet of soil cover. Taking into consideration the data from the RI/RA, the volume of waste plus impacted material currently covered is estimated at 1.0 million cubic yards (yd^3), within a surface area of approximately 50 acres. Volume calculations are provided in Appendix D.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

ARAR	Citation/Reference	Type	Rationale for Use at Site 1, Naval Station Great Lakes
FEDERAL			
Safe Drinking Water Act Maximum Contaminate Levels (MCLs), MCL Goals, and Secondary MCLs	40 Code of Federal Regulations (CFR) 140-143	Potentially applicable	Would be used as protective levels for groundwater that is a current or potential future drinking water source. However, groundwater is not currently used as a potable water source and is not expected to be used as a potable water source in the future at Site 1.
Preliminary Remediation Goals	U.S. EPA Region 9, 2004	To Be Considered (TBC)	Benchmark values for assessing the need for soil, groundwater, and air remedial action/corrective measures.
Generic Soil Screening Levels	U.S. EPA, 1996b	TBC	Benchmark values for assessing the need for soil remedial action /corrective measures. The SSLs assess the potential migration of chemicals from soil to air and from soil to groundwater.
Resource Conservation and Recovery Act Subtitle C – Hazardous Waste Identifications and Listing Regulations	40 CFR 261	Potentially applicable	Would be used to identify a material as a hazardous waste and thus determine the applicability and relevance of RCRA C Hazardous Waste Rules.
U.S. EPA Health Advisories	U.S. EPA, 1996a	TBC	Benchmark values for assessing the need for groundwater remedial action/corrective measures.
STATE			
Illinois EPA Tiered Approach to Corrective Action; residential soil remediation objectives	Illinois EPA, 2005	TBC	Benchmark values for assessing the need for soil, groundwater, and air remedial action/corrective measures. The remediation objectives assess ingestion of soil, inhalation of chemicals from soil, migration of chemicals from soil to groundwater, and ingestion of groundwater.

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs AND TBCs
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

ARAR	Citation/Reference	Type	Rationale for Use at Site 1, Naval Station Great Lakes
FEDERAL			
U.S. EPA's Groundwater Protection Strategy	U.S. EPA, 1984	To Be Considered	Surficial groundwater at Site 1 is likely designated as Class IIIA: Special Resource Groundwater.
Historic Sites, Buildings, and Antiquities Act of 1935	16 U.S. Code (U.S.C.) 461 et seq.	Potentially Applicable	This act would be applicable if information is found to classify Site 1 as a historic or prehistoric property of national significance. No historic sites or buildings are known to exist at Site 1.
Archaeological and Historic Preservation Act of 1974	16 U.S.C. 469 et seq.	Potentially Applicable	This act would be applicable if historic and archaeological artifacts were to be affected by remedial activities. No such artifacts are known to exist within the boundaries of Site 1.
Archaeological Resources Protection Act of 1979	16 U.S.C. 479(aa) et seq.	Potentially Applicable	This act would be applicable if archaeological artifacts were discovered during remedial activities. No such artifacts are known to exist within the boundaries of Site 1.
Conservation Programs on Military Reservations (Sikes Act) of 1960, as Amended	16 U.S.C. 670(a) et seq.	Applicable	This act requires that military installations manage natural resources for multipurpose uses and public access appropriate for those uses consistent with the military department's mission.
Endangered Species Act Regulations	50 Code of Federal Regulations (CFR) Parts 81, 225, 402	Potentially Applicable	If a site investigation or remediation activity could potentially affect an endangered species or their habitat, these regulations would apply. No such species are known to inhabit Site 1.
Fish and Wildlife Coordination Act Regulations	40 CFR Section 6.302 and 33 CFR Subsection 320.3	Potentially Applicable	If the Site 1 remedial alternative involves the alteration of a stream or wetland, these agencies would be consulted. If modifications must be conducted, the regulation requires that adequate protection be provided for fish and wildlife resources.
National Environmental Policy Act (NEPA) Regulations: Wetlands, Floodplains, etc.	40 CFR Subsection 6.302 (a)	Potentially Applicable	If the Site 1 remedial alternative adversely affects a wetland, these regulations apply.
NEPA Regulations: Floodplain Management, Executive Order 11988	40 CFR Part 6, Appendix A	Potentially Applicable	If the Site 1 remedial action takes place in a floodplain, alternatives that would reduce the risk of flood loss and restore/preserve the floodplain must be considered.

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs AND TBCs
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

ARAR	Citation/Reference	Type	Rationale for Use at Site 1, Naval Station Great Lakes
STATE			
Illinois Wetland Protection Program	Chapter 20 Department of Natural Resources, Act 830	Potentially Applicable	If a remedial action could potentially affect a wetland, this policy would be considered.
Illinois Threatened and Endangered Species Regulations	520 Illinois Compiled Statutes 10/1	Potentially Applicable	This act would be considered in conjunction with the federally listed endangered species act if a site investigation or remediation could potentially affect a state-listed threatened or endangered species.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

ARAR	Citation/Reference	Type	Rationale for Use at Site 1 and 4, Naval Station Great Lakes
FEDERAL			
Solid Waste Disposal Act / Resource Conservation and Recovery Act Subtitle C	42 U.S. Code (U.S.C.) 6905, 6912a, 6924-6925	_	_
• Standards for Hazardous Waste Generators	40 Code of Federal Regulations (CFR) 262	Potentially applicable	Applicable for removed site wastes determined to be hazardous.
• Standards for Hazardous Waste	40 CFR 263	Potentially applicable	Applicable for site wastes determined hazardous that are transported off site.
• Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs)	40 CFR 264	Potentially applicable	These regulations would be applicable to waste removed from the site including both on-site and off-site management.
• Interim Status Standards for Owners and Operators of Hazardous Waste TSDFs	40 CFR 265	Relevant and appropriate	Establishes design and operating criteria for hazardous landfills.
• RCRA Land Disposal Restrictions Requirements	40 CFR 268	Potentially applicable	If off-site treatment or disposal of contaminated media and/or disposal of treatment residuals that may be considered hazardous waste is necessary, it would be subject to LDRs.
Hazardous and Solid Waste Amendments of 1984	42 U.S.C. 6926	Potentially Applicable	Establishes a corrective actions program requiring four basic elements (assessment, investigation, corrective measures study, implementation).
The Clean Water Act National Pollution Discharge Elimination System	40 CFR 122	Potentially applicable	These requirements are applicable for alternatives that include a surface water discharge.
Clean Air Act National Ambient Air Quality Standards	42 U.S.C §7401- 7642, 40 CFR Part 50	Potentially applicable	Remedial action/corrective measures involving treatment of media could result in emissions to the atmosphere.
Department of Transportation Hazardous Materials Transportation	49 CFR	Potentially applicable	These rules are considered potentially applicable depending on whether wastes are shipped off site for laboratory analysis, treatment, or disposal.
Occupational Safety and Health Administration Standards	29 CFR 1910.120	Applicable	On-site activities are required to follow OSHA requirements.

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs AND TBCs
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

ARAR	Citation/Reference	Type	Rationale for Use at Site 1 and 4, Naval Station Great Lakes
FEDERAL (continued)			
National Environmental Policies Act (NEPA)	42 U.S.C 4321 et seq.	Relevant and appropriate	Remedial action/corrective measures could constitute significant activities, thereby making NEPA requirements ARARs; however, activities conducted in accordance with the National Contingency Plan are considered to meet the substantive NEPA requirements.
Soil Conservation Act	U.S.C. 5901 et seq.	Applicable	During remedial activities, implementation of soil conservation practices would be required.
National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Potentially applicable	Remedial activities that generate fugitive dust or incineration would require emission standards for designated hazardous pollutants.
STATE			
Illinois Waste Disposal (Hazardous)	35 Illinois Administrative Code (IAC) 721, 722, 723, 724, and 728	Potentially Applicable	These regulations would apply if waste on-site was deemed hazardous and needed to be stored, transported, or disposed properly.
Illinois Solid Waste and Special Waste Hauling	35 IAC 809	Potentially Applicable	These regulations would apply if waste is transported to a disposal facility.
Illinois Emission Standards for Hazardous Air Pollutants	35 IAC Subtitle B, Chapter I	Potentially applicable	Remedial activities that generate fugitive dust or incineration would require emission standards for designated hazardous pollutants.
Illinois Environmental Protection Act	415 Illinois Compiled Statute 5/1, Titles II, III, V, and VI	Applicable	These regulations include requirements for air pollution, water pollution, land pollution and refuse disposal, and noise pollution.
Illinois Groundwater Quality Regulations	35 IAC 620	Applicable	These regulations establish groundwater monitoring and reporting requirements as determined under the Permit Section of the Division of Land Pollution Control.
Illinois Landfill Closure Regulations	35 IAC 807.305(c), 807.502(a) and (b), 811.110(g), 811.111(c), 811.111(d), 811.314(b)(3)(ii), 811.314(c)(1) and (3), 811.318, 811.319, 811.320, 811.324	Relevant and appropriate	These regulations establish landfill closure requirements, including monitoring and maintenance.

3.0 SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential remediation technologies and process options that may be applicable to remedial alternatives for the Site at Naval Station Great Lakes. The primary objective of this phase of the FFS is to develop an appropriate range of remedial technologies and process options that will be used for developing remedial alternatives. Given the applicability of the presumptive remedy approach to the Site, containment is the recommended remedy with appropriate modifications to address the remaining RAOs described in Section 2.1.

The basis for remediation technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Identification of ARARs
- Development of RAOs
- Identification of GRAs
- Identification of volume and areas of media of concern

Remediation technology screening is performed in this section with the completion of the following analytical steps:

- Identification and screening of remediation technologies and process options
- Evaluation and selection of representative process options

In this section, a variety of remediation technologies and process options are first identified for each of the GRAs listed in Section 2.2 and then screened. The selection of remediation technologies and process options for initial screening is based on the Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA (U.S. EPA, 1988). The screening is first conducted at a preliminary level to focus on relevant remediation technologies and process options. The screening is then conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the remediation technologies that have passed the detailed evaluation and screening.

U.S. EPA has developed a response action or presumptive remedy for CERCLA municipal landfills, which should also be applied to appropriate military landfills. The conditions at the Site meet the presumptive remedy guidelines, so the requirement to conduct an initial identification of and to screen alternative technologies (other than source containment) has been eliminated.

The presumptive remedy includes monitoring, implementation of institutional controls, and containment via maintenance of the existing soil cover.

3.1 PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The preliminary screening of remediation technologies and process options is based on overall applicability to the media of concern, COCs, and specific conditions present at the Site. Table 3-1 summarizes the preliminary screening of remediation technologies and process options by presenting the GRAs, identifying the remediation technologies and process options, and providing a brief description of each process option followed by a screening comment. The following are the technologies and process options retained for detailed screening:

3.2 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

3.2.1 No Action

No Action would consist of "walking away" from the site without implementing any remedial action or performing any monitoring and/or maintenance. As required under CERCLA regulations, the No Action alternative is carried through the FFS to provide a baseline for comparison to other alternatives and their effectiveness in mitigating risks posed by site COCs.

3.2.1.1 Effectiveness

The No Action alternative would not be effective in reducing risks or meeting the RAOs and PRGs because no exposure control or treatment would be performed. Because no monitoring or maintenance would be performed, the No Action alternative would not be effective in evaluating the potential migration of COCs, or the potential reduction of COC concentrations through monitored natural attenuation.

3.2.1.2 Implementability

There would be no implementability concerns because no actions would be implemented.

3.2.1.3 Cost

There would be no costs associated with the No Action alternative.

3.2.1.4 Conclusion

Although it would not be effective, the No Action alternative will be retained for comparison to other options.

3.2.2 Institutional Controls

Based on site conditions the institutional controls implemented at the Site would include property and groundwater use restrictions. The institutional controls may also include deed restrictions to prevent the site from being used for residential purposes, and may require continued maintenance of the cap and existing drainage features such as the Skokie Ditch. The installation of groundwater wells (other than for use as environmental monitoring wells) would be prohibited.

By separate Memorandum of Agreement (MOA) dated September 1, 2002, with the Illinois EPA and Naval Station Great Lakes, on behalf of the Department of the Navy, agreed to implement base-wide, certain periodic Site inspection, condition certification, and agency notification procedures to ensure the maintenance by Naval Station Great Lakes personnel of any site-specific land use controls (LUCs) deemed necessary for present or future protection of human health and the environment. A fundamental premise underlying execution of this agreement was that through the Navy's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to the Illinois EPA as to the permanency of those remedies that included the use of specific LUCs.

Through LUCs institutional controls will be implemented under this agreement. The LUCs will be developed and implemented by a LUC Remedial Design that will identify the objectives, implementation, and enforcement of the LUCs. Annual site inspections will be conducted to verify continued implementation of these LUCs. In addition, the Illinois EPA and Navy have signed a LUC-MOA that includes a Naval Station Policy Letter restricting use of groundwater on Naval Station Great Lakes property.

Effectiveness

Institutional controls alone would not effectively reduce the concentrations of the Site COCs. However, institutional controls would be an effective tool to prevent future exposure to unacceptable concentrations of COCs.

Implementability

Institutional controls have been implemented throughout Naval Station Great Lakes and could be readily implemented at the Site.

Cost

Costs to implement and maintain institutional controls at the Site would be low.

Conclusion

Institutional controls are retained in combination with other technologies and process options for the development of remedial alternatives. This technology meets the requirements of the presumptive remedy guidelines.

3.2.3 Monitoring

Monitoring would consist of regularly collecting and analyzing samples of impacted media to assess trends in concentrations of COCs and to evaluate for the potential migration of these COCs.

Effectiveness

Monitoring alone would not be effective in reducing concentrations of the Site COCs. However, monitoring would be an effective tool to evaluate the progress of natural attenuation processes or remediation and to evaluate the potential migration of COCs.

Implementability

A sampling and analysis program would be readily implementable at the Site utilizing existing monitoring wells.

Cost

Costs associated with monitoring would be moderate.

Conclusion

Monitoring is retained in combination with other process options for the development of remedial alternatives. This technology meets the requirements of the presumptive remedy guidelines.

3.2.4 Containment

3.2.4.1 In-situ Capping

In-situ capping is considered for containment of contaminated landfill media at the Site. In-situ capping would require maintenance of the existing Site soil cover

Effectiveness

In-situ capping does not reduce concentrations of COCs, but it does effectively minimize exposure of human and ecological receptors through direct contact with subsurface soil and landfill contents. In-situ capping also significantly reduces the potential for migration of COCs either through reduction of infiltration or migration of contaminated sediment to previously non-contaminated areas through erosion.

Implementability

In-situ capping would be implementable, and the necessary resources, equipment, and material are readily available.

Cost

The capital and operation and maintenance (O&M) costs of in-situ capping would be moderate.

Conclusion

In-situ capping is retained for development of remedial alternative. This technology meets the requirements of the presumptive remedy guidelines.

3.2.4.2 Surface Water Controls

Surface water controls would consist of repairing or relocating the deteriorated Skokie Ditch infrastructure, reducing the potential for migration of COCs through reduction of infiltration, and reduction of contaminated sediment migration. This action would help prevent the generation of leachate by decreasing the amount of surface water entering the landfill. Additionally, it would also prevent groundwater and eroded materials from entering the pipe, decreasing the chance of impacted surface water and sediment discharge.

Effectiveness

Surface water controls would be effective in minimizing infiltration, leachate generation, and leachate discharge routes.

Implementability

Surface water controls would be moderately easy to implement, and the resources, materials, and services required to implement this technology are readily available.

Cost

Capital and O&M costs for surface water control would be moderately high.

Conclusion

Surface water controls are retained for the development of remedial alternatives. This technology meets the requirements of a non-presumptive remedy component under the guidelines.

3.2.4.3 Sediment Protection

Sediment protection would consist of placing riprap lining in portions of the Skokie Ditch to prevent direct exposure of human receptors to COCs in sediment. The riprap lining would consist of a geotextile liner and a properly graded stone/riprap revetment that would effectively reduce the potential for erosion along Skokie Ditch. Sediment protection along with surface water controls would also significantly reduce the potential for migration of COCs either through diffusion from sediment to surface water or through erosion and spreading of contaminated sediment to previously noncontaminated areas.

Effectiveness

Sediment protection would be effective in preventing direct contact with contaminated media. The surface protection would also be effective in minimizing erosion. The installed sediment protection would need to be inspected and maintained/repaired to ensure its effectiveness over time.

Implementability

Sediment protection would be moderately easy to implement; and the resources, materials, and services required to implement this technology are readily available.

Cost

Capital and O&M costs for sediment protection would be moderate.

Conclusion

Sediment protection is retained in combination with other process options for the development of remedial alternatives. This technology meets the requirements of a non-presumptive remedy component under the guidelines.

3.2.5 Removal

The only technology considered for removal is mechanical excavation. Mechanical excavation of the impacted subsurface soil and landfill contents would be performed using excavators. After the excavation is completed, the location is filled and graded with clean fill material or treated soil. Because of the proximity to residential areas (approximately 750 feet), emissions, dust, and debris produced as a result of the remedial action would have to be strictly controlled.

Effectiveness

Mechanical excavation would not reduce concentrations of COCs in waste and impacted soil, but it would be an effective means for removing from the site the materials with concentrations of COCs greater than PRGs.

Implementability

Mechanical excavation of subsurface soil and landfill contents would be implementable, and the necessary resources, equipment, and materials are readily available. Controls would have to be implemented to divert surface water around the areas to be excavated and, depending on the areas to be excavated and site conditions at the time of excavation, the use of tracked equipment may be required. Since groundwater may be encountered, processes would be needed to manage, treat, and dispose of it.

It is anticipated that, based on soil borings and information regarding past operations, half of the material excavated would be relatively clean and could be replaced in the excavation. Of the remaining material, it is estimated that half could be disposed as a non-hazardous material and the remaining half would require off-site disposal in a hazardous waste landfill.

This option would result in the loss of a valuable recreational resource.

Cost

The cost of mechanical excavation would be high and is estimated to be over $30 million, assuming that the waste and impacted material encountered could be disposed as either a non-hazardous or hazardous material.

Conclusion

Mechanical excavation is eliminated from further consideration due to high cost and because the Site meets the requirements for the presumptive remedy.

3.3 SELECTION OF REPRESENTATIVE PROCESS OPTIONS

The following technologies and process options are retained to develop remedial alternatives for the Site:

- No Action
- Institutional Controls
- Monitoring
- Containment (in the form of in-situ capping, surface water controls, and sediment protection)

TABLE 3-1

REMEDIATION TECHNOLOGIES
SITE 1 (GOLF COURSE LANDFILL) AND
SITE 4 (FIRE FIGHTING TRAINING UNIT) FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

GRA	Remediation Technology	Process Option
No Action	None	Not applicable
Institutional Controls	Land Use Controls	Legal restrictions on land use
Monitoring	Engineering Controls	Sampling and analysis of natural attenuation and off-site migration
Containment	In-Situ Capping	Maintenance of existing soil cover/barriers
	Surface Water Controls	Relocation/Replace of Skokie Ditch infrastructure
	Sediment Protection	Riprap lining of Skokie Ditch
Removal	Excavation/Disposal	Off-base landfilling

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

In this section, the remedial technologies retained from the components selected in Section 3.0 are assembled into remediation alternatives. This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP of 40 CFR Part 300, as revised in 1990. The criteria required by the NCP and the relative importance of these criteria are described in the following subsections.

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

4.1.1.1 Overall Protection of Human Health and the Environment

Alternatives are assessed for adequate protection of human health and the environment, in both the short and long term, from unacceptable risks posed by hazardous substances or contaminants present at the site. For this purpose, alternatives should eliminate, reduce, or control exposure to concentrations of contaminants exceeding remediation goals. Overall protection draws on the assessments of other evaluation criteria, especially compliance with ARARs, long-term effectiveness and permanence, and short-term effectiveness.

4.1.1.2 Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under federal and state environmental or facility siting regulations. If one or more regulations that are applicable cannot be complied with, a waiver must be invoked by the appropriate regulatory body for the alternative to be considered acceptable. Grounds for invoking a waiver include the following circumstances:

- The alternative is an interim measure and will become part of a total remedial action that will attain the ARAR.

- Compliance will result in greater risk to human health and the environment.

- Compliance is technically impracticable from an engineering perspective.

- The alternative will attain a standard of performance equivalent to that required under the otherwise applicable standard, requirement, or limit through use of another method or approach.

- A state requirement has not been consistently applied, or the state has not demonstrated the intention to consistently apply the promulgated requirement in similar circumstances at other remedial actions within the state.

- For CERCLA-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of CERCLA monies to respond to other sites that may present a threat to human health and the environment. This circumstance is not applicable for the Site because remedial action will not be funded by CERCLA..

4.1.1.3 Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative will prove successful. Factors considered, as appropriate, include the following:

- Magnitude of Residual Risk: Risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and Reliability of Controls: Controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. In particular, the following should be addressed: the uncertainties associated with land disposal for providing long-term protection from residuals; the potential need to replace technical components of the alternative (such as a cap, slurry wall, or treatment system); and the potential exposure pathways and risks posed if the remedial action needs replacement.

4.1.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives are assessed for the degree to which they employ recycling or treatment that reduces the toxicity, mobility, or volume (including how treatment is used) to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that these processes will treat.

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.

- The degree of expected reduction in toxicity, mobility, or volume of waste due to treatment or recycling and the specification of which reduction(s) is occurring.

- The degree to which the treatment is irreversible.

- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.

- The degree to which treatment reduces the inherent hazards posed by principal threats at the site.

4.1.1.5 Short-Term Effectiveness

The short-term impacts of the alternative are assessed considering the following:

- Short-term risks that might be posed to the community during implementation.

- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures taken to address these impacts.

- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.

- Time until protection is achieved.

4.1.1.6 Implementability

The ease or difficulty of implementing the alternatives is assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies.

- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and the availability of prospective technologies.

4.1.1.7 Cost

Capital costs include both direct and indirect costs. A net present worth (NPW) of the capital and O&M costs is also provided. Typically, the cost estimate accuracy range is plus 50 percent to minus 30 percent.

4.1.1.8 State Acceptance

The State of Illinois' concerns that must be assessed include the following:

- The state's position and key concerns related to the preferred alternative and other alternatives.
- State comments on ARARs or the proposed use of waivers.

These concerns cannot be evaluated at this time in the FFS because the state has yet to review and comment on the FFS. These concerns will be discussed, to the extent possible, in the Proposed Plan to be issued for public comment.

4.1.1.9 Community Acceptance

The community acceptance assessment involves the responses of the community to the Proposed Plan and includes determining which components of the alternatives the interested persons in the community support, have reservations about, or oppose. This assessment can be performed after comments on the Proposed Plan are received from the public.

4.1.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives. These criteria include:

- State Acceptance
- Community Acceptance

These two criteria are considered to be modifying criteria that must be considered during remedy selection. State acceptance will be addressed in the Final FFS. The last criterion, community acceptance, cannot be completely evaluated until the Proposed Plan has been discussed in a public meeting. Therefore, this document addresses only seven of the nine criteria for each alternative.

4.1.3 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan to the community for review and comment. The preferred alternative must meet the following criteria:

- Protection of human health and the environment.
- Compliance with ARARs unless a waiver is justified.
- Cost effectiveness in protecting human health and the environment and in complying with ARARs.
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

The second step consists of the Navy's review of the public comments and a determination of whether or not the preferred alternative continues to be the most appropriate remedial action for the site, in consultation with Illinois EPA.

4.2 ASSEMBLY OF REMEDIAL ALTERNATIVES

This section develops the remedial alternatives for the Site. Additional site-specific information and assumptions are provided in this section to further explain the alternative development process.

Based on the technology screening presented in Section 3.0, and taking into consideration the presumptive remedy guidance, the following two remedial alternatives were developed the Site:

- Alternative 1: No Action
- Alternative 2: Containment, Institutional Controls, and Monitoring (Presumptive Remedy)

Alternative 1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 2 was formulated and analyzed to evaluate the presumptive remedy and its components. A description and detailed analysis of these alternatives are presented in the following sections.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.3.1 Alternative 1: No Action

4.3.1.1 Description

The No Action alternative maintains the site as is. This alternative does not address site contamination and is only retained to provide a baseline for comparison to other alternatives, as required under CERCLA. There would be no reduction in toxicity, mobility, or volume of COCs other than what might result from natural processes such as dispersion, dilution, biodegradation, and other attenuating factors. The site would be available for unrestricted use.

4.3.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 1 would not provide for protection of human health and the environment. The potential for exposure of human receptors to contaminated subsurface soil, landfill contents, and groundwater would increase over time because the existing soil cover would not be maintained, and no site-specific institutional controls would be implemented. This option does not address exposure risks associated with COCs in surface water and sediment. Also, under this alternative, no monitoring would occur; therefore, no warning would be provided if concentrations of contaminants were to migrate off site.

Compliance with ARARs and TBCs

Alternative 1 would not comply with chemical-specific ARARs or TBCs because no action would be taken to reduce COC concentrations. Compliance with location-specific ARARs or TBCs would be purely coincidental. This alternative does not comply with landfill closure requirements that are action-specific ARARs.

Long-Term Effectiveness and Permanence

Alternative 1 would have no long-term effectiveness and permanence because nothing would be done to reduce concentrations of site COCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur. Some reduction in the toxicity and/or volume of COCs may occur through natural attenuation, but no monitoring would be performed to verify this.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment.

Alternative 1 would not achieve the RAOs or the PRGs.

Implementability

Because no action would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The implementability of administrative measures is not applicable because no such measures would be taken.

Cost

There would be no costs associated with Alternative 1.

State Acceptance

The Illinois EPA has indicated that Alternative 1 would not be an acceptable alternative.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

4.3.2 Alternative 2: Containment, Institutional Controls, and Monitoring (Presumptive Remedy)

4.3.2.1 Description

Alternative 2 is illustrated on Figure 4-1 and would consist of three major components: (1) containment, (2) institutional controls, and (3) monitoring.

Component 1: Containment

Containment would consist of maintaining the existing in-situ cap. The existing in-situ cap is a soil cover that consists of a minimum of 3 feet of clean fill material, which would be maintained to prevent direct contact with COCs and erosion and scour of impacted soil and wastes. Containment would also include implementing surface water controls through the relocation of the existing Skokie Ditch infrastructure as recommended in the Technical Memorandum in Appendix B. The area near the downstream end of existing pipe where the soil cover thickness was identified as being less 2 feet thick will be repaired as part of the pipe relocation. A riprap liner, consisting of a geotextile layer and a properly graded stone/riprap revetment would be placed over the sediment in Skokie Ditch to prevent human exposure to the COCs in that media.

Component 2: Institutional Controls

Institutional controls would be incorporated into the Base Master Plan via LUCs to ensure that the restrictions on groundwater use established in the LUC MOA are applied and enforced at the Site, regardless of changes in Navy policy throughout the Naval Station. These LUCs would be required until monitoring (see Component 3) verifies that site RAOs have been achieved and include a restriction on property/site to insure that there is no residential development on the property. Additionally, LUCs would require review of construction activities and intrusive work conducted at the Site, to protect workers, to ensure that the in-situ cap is repaired appropriately and in kind, consistent with the materials, and their specifications being disturbed, and to confirm proper management of contaminated materials.

Component 3: Monitoring

Monitoring would consist of regularly collecting samples of impacted site groundwater and surface water and analyzing these samples for COCs. Samples would be collected both in the areas of known contamination to assess expected natural attenuation recovery over time and immediately outside of these areas to detect contaminant migration.

For the purpose of this FFS, it is assumed that 12 groundwater and 5 surface water samples would be collected. Initial sampling will occur on a quarterly basis in accordance with Section 811.319 Title 35 of the Illinois Administrative Code. After five years, recommendations to reduce parameters and frequency may be made. Monitoring would be performed annually for a minimum of 30 years.

4.3.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 2 would be protective of human health and the environment. Containment would protect human health by limiting exposure to contaminated subsurface soils and landfill content, surface water, and sediment. Institutional controls in the form of LUCs would prevent future development of the site and minimize exposure to site groundwater.

Monitoring would be protective of human heath and the environment by assessing the progress of natural attenuation processes and by verifying that COCs are not migrating from the capped areas.

Compliance with ARARs and TBCs

Alternative 2 could comply with all chemical-, location-, and action-specific ARARs and TBCs with two exceptions as noted below.

This alternative would not comply with chemical-specific ARARs in the short-term, but long-term compliance could be achieved through natural attenuation.

Secondly, since the landfill was closed prior to 1970, landfill closure regulations identified as action-specific ARARs are relevant and appropriate but not necessarily applicable. Regardless, Alternative 2 meets all these ARARs with one exception. While Alternative 2 does meet the cover requirements for a Sanitary Landfill (35 IAC 807.305), due to the lack of testing, permeability of the cover cannot be confirmed. Therefore, it cannot be confirmed if closure meets 35 IAC 811.314 (b) which establishes permeability requirements for final cover systems of new solid waste landfills. Data does show that where waste materials were encountered in the borings, they were found to be covered with a minimum of 2 feet and on average 6.5 feet of soil. And, aside from the thin layers of ash/burn material, the cover consisted predominately of low-permeability brown silty clay. The one area where the cover thickness was identified as being less than 2 feet through prior investigation will be repaired as part of the Skokie Ditch relocation. As an aside, correlation of groundwater and soil analytical data support an argument that only a handful of isolated incidences and locations were leaching due to infiltration can be related to groundwater exceedances. This supports a claim that the existing cover system meets the requirements of 35 IAC 811.314 (b). Lastly, restrictions to groundwater usage will limit any potential risk caused by impacts and, monitoring programs will identify potential off-site discharges and trigger remedial actions.

Long-Term Effectiveness and Permanence

Alternative 2 would provide long-term effectiveness and permanence. Although no treatment would be used to reduce COC concentrations in the contaminated site media, these media would be effectively contained to limit exposure to human receptors.

Monitoring would be a means to assess the effectiveness of natural attenuation processes and to verify that COCs are not migrating from the capped area.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would reduce the mobility of COCs by reducing surface water infiltration and reducing the diffusion and/or erosion of contaminated sediment. Maintenance of the cover would increase evapotranspiration, and surface water controls will help to reduce the generation and discharge of impacted groundwater. Monitoring would be performed to detect reductions in the toxicity and/or volume of COCs that may occur through natural attenuation.

Short-Term Effectiveness

Alternative 2 would be effective in the short-term. Implementation of this alternative would not adversely impact the surrounding community or the environment.

Because it helps minimize or restrict exposure it is estimated that Alternative 2 would achieve the RAOs upon implementation of the institutional controls.

Implementability

Alternative 2 would be implemented fairly readily. Continued maintenance of the existing soil cover, implementation of institutional controls, and sampling and analysis of site surface water and groundwater could readily be accomplished. Replacing or relocation of the Skokie Ditch infrastructure and placement of a protective layer of riprap over sediments in Skokie Ditch will require design effort but the resources, equipment, and materials required to implement these activities are currently available.

The administrative aspects of Alternative 2 would be moderately simple to implement. Construction permits would be required for this alternative. Deed restrictions would ensure continued implementation of institutional controls in the event there is a change in property ownership. The site would be added to the LUC Memorandum of Agreement with the addition of a LUC Implementation Plan to the appendix of that document. This would require an annual review of the LUCs to ensure they are being maintained and properly enforced.

Cost

The estimated costs for Alternative 2 are:

- Capital Cost: $1,612,000
- 30-Year NPW Worth of O&M Costs: $621,000
- 30-Year NPW: $2,233,000

The above figures have been rounded to the nearest $1,000 to reflect the very preliminary nature of these estimates. A detailed breakdown of these costs is provided in Appendix E.

State Acceptance

This assessment will be performed prior to issuance of the Proposed Plan.

Community Acceptance

This assessment will be performed after comments on the Proposed Plan are received from the public.

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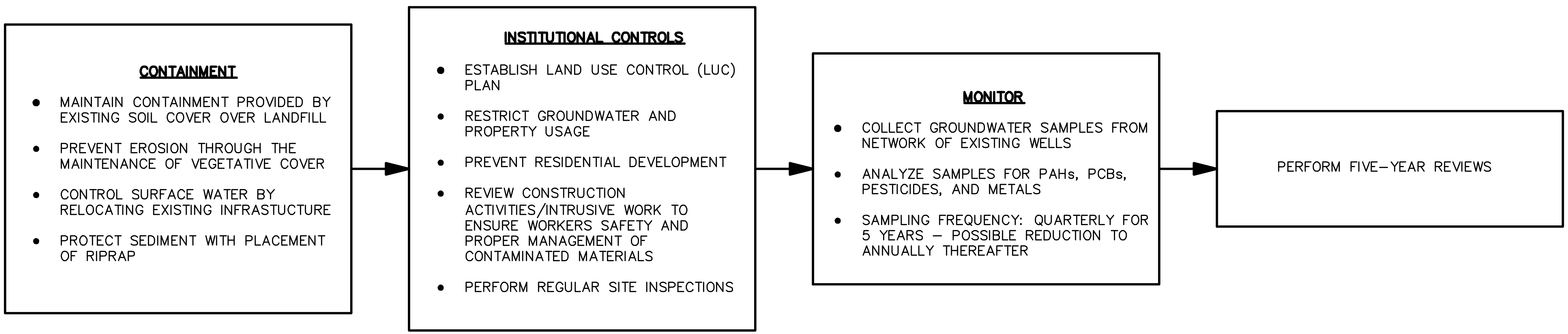
CONTAINMENT, INSTITUTIONAL CONTROLS, AND MONITORING



DRAWN BY BDC — DATE 3/28/08	NAVFAC	BLOCK FLOW DIAGRAM ALTERNATIVE 2 SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTER TRAINING UNIT) NAVAL STATION GREAT LAKES, ILLINOIS	CONTRACT NO. 0506
CHECKED BY — DATE			OWNER NO. 0000
REVISED BY — DATE			APPROVED BY — DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4–1 — REV. 0

FORM CADD NO. SDIV-BH.DWG - REV 1 - 9/10/98

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the analyses that were presented for each of the remedial alternatives in Section 4.0. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

5.1 COMPARISON OF REMEDIAL ALTERNATIVES BY CRITERIA

The following remedial alternatives are compared in this section:

- Alternative 1: No Action
- Alternative 2: Containment, Institutional Controls, and Monitoring

5.1.1 <u>Overall Protection of Human Health and the Environment</u>

Alternative 1 would not provide for protection of human health and the environment. The potential for exposure of human receptors to contaminated subsurface soil, landfill contents, and groundwater would increase over time because the existing soil cover would not be maintained and no site-specific institutional controls would be implemented. Exposure to COC's in surface water and sediments are not addressed. Also, under this alternative, no monitoring would occur; therefore, no warning would be provided if concentrations of contaminants were to migrate off site.

Of the two, Alternative 2 would provide the higher level of protection because the existing soil cover would be maintained to prevent exposure to impacted subsurface soil and landfill contents and along with provision to prevent casual exposure to surface water and sediment. Institutional controls would be implemented to prevent the use of site groundwater, to protect site workers, and restrict residential land use. In addition, the monitoring component of Alternative 2 would provide indication of potential future migration of COCs.

5.1.2 <u>Compliance with ARARs and TBCs</u>

Alternative 1 would not comply with chemical-specific ARARs or TBCs because no action would be taken to reduce COC concentrations. Compliance with location-specific ARARs or TBCs would be purely coincidental. Action-specific ARARs or TBCs are not applicable.

Alternative 2 would comply with chemical-, location-, and action-specific ARARs and TBCs because it will minimize or restrict exposure to COCs. This alternative would not comply with chemical-specific ARARs in the short-term, but long-term compliance could be achieved through natural attenuation.

5.1.3 Long-Term Effectiveness and Permanence

Alternative 1 would have no long-term effectiveness and permanence because nothing would be done to reduce concentrations of site COCs.

Although no treatment would be used to reduce COC concentrations in the contaminated site media, these media would be effectively contained to limit exposure to human receptors. Alternative 2 would therefore provide long-term effectiveness and permanence.

The monitoring component of Alternative 2 would be a means to assess the effectiveness of natural attenuation processes and to verify that COCs are not migrating from the capped area.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur. Some reduction in the toxicity and/or volume of COCs may occur through natural attenuation, but no monitoring would be performed to verify this.

Alternative 2 would reduce the mobility of COCs by reducing surface water infiltration and reducing the diffusion and/or erosion of contaminated sediment. Monitoring would be performed to detect reductions in the toxicity and/or volume of COCs that may occur through natural attenuation.

5.1.5 Short-Term Effectiveness

Because no action would occur, implementation of Alternative 1 would not pose risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative 1 would not achieve the RAOs.

Alternative 2 would be effective in the short-term. Implementation of this alternative would not adversely impact the surrounding community or the environment. Because it helps minimize or restrict exposure it is estimated that Alternative 2 would achieve the RAOs upon implementation of the institutional controls and a soil cover maintenance plan.

5.1.6 Implementability

Alternative 1 would be easy to implement because no action would be taken.

Alternative 2 would be readily implementable. Continued maintenance of the existing cover, implementation of institutional controls, and sampling and analysis of site surface water and groundwater could readily be accomplished. The resources, equipment, and materials required to implement these activities are currently available.

The administrative aspects of Alternative 2 would be relatively simple to implement. No construction permits would be required for this alternative. Deed restrictions would ensure continued implementation of institutional controls in the event there is a change in property ownership, and LUCs would be reviewed annually to ensure proper maintenance and enforcement of administrative controls. The site would be added to the LUC Memorandum of Agreement with a LUC Implementation Plan.

5.1.7 Cost

The capital and O&M costs and NPW of the alternatives are summarized as follows:

Table 0.1

Alternative	Capital ($)	NPW of O&M ($)	NPW ($)
1	0	0	0
2	1,612,000	621,000 (30-year)	2,233,000 (30-year)

Detailed cost estimates are provided in Appendix E.

5.2 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 5-1 summarizes the comparative analysis of the two remedial alternatives.

TABLE 5-1

SUMMARY OF COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 1: No Action	Alternative 2: Containment, Institutional Controls, and Monitoring
Overall Protection of Human Health and Environment	Would not provide for protection of human health and the environment. The potential for exposure of human receptors to contaminated site media would increase over time because the existing soil cover would not be maintained and no site-specific institutional controls would be implemented. Also under this alternative, no monitoring would occur; therefore, no warning would be provided if concentrations of contaminants were to migrate off site.	Would provide a higher level of protection because the existing soil cover would be maintained to prevent exposure to impacted subsurface soil and landfill contents, and institutional controls would be implemented to prevent the use of site groundwater, protect site workers, and provide land use restrictions. In addition, the monitoring component of Alternative 2 would provide indication of any future migration of COCs.
Compliance with ARARs and TBCs:		
Chemical-Specific	Would not comply	Would not comply
Location-Specific	Would not comply	Would comply
Action-Specific	Not applicable	Would comply
Long-Term Effectiveness and Permanence	Would not be long-term effective or permanent.	Would be long-term effective and permanent.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not achieve reduction of toxicity, mobility, or volume of contaminants through treatment because no treatment would occur.	Would reduce the mobility of COCs by reducing surface water infiltration and the diffusion and/or erosion of contaminated sediment. Monitoring would be performed to detect reductions in the toxicity and/or volume of COCs that may occur through natural recovery.
Short-Term Effectiveness	Would not result in short-term risks to remediation workers or adversely impact the surrounding community because no action would occur. Would not achieve RAOs or attain PRGs.	Would be effective in the short-term. Implementation would not adversely impact the surrounding community or the environment. Estimated to achieve the RAOs upon implementation of institutional controls and a soil cover maintenance plan.

TABLE 5-1

**SUMMARY OF COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES
SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS**

Evaluation Criterion	Alternative 1: No Action	Alternative 2: Containment, Institutional Controls, and Monitoring
Implementability	Would be easy to implement because no action would be taken.	Would be readily implementable. Continued maintenance of the existing cover, implementation of institutional controls, and sampling and analysis of site surface water and groundwater could readily be accomplished. The resources, equipment, and materials required to implement these activities are currently available. No construction permits would be required for this alternative, but LUCs would need to be maintained and deed restrictions would need to be implemented to ensure LUCs in the event there is a change in property ownership. The site would be added to the LUC Memorandum of Agreement with a LUC Implementation Plan. Annual review of LUCs would be conducted to ensure maintenance and enforcement are properly implemented.
Costs: Capital NPW of O&M NPW	 $0 $0 $0	 $1,612,000 $621,000 $2,233,000
State Acceptance	Illinois EPA has indicated this alternative is unacceptable	Illinois EPA has indicated this alternative is generally acceptable but final approval would be performed prior to issuance of the Proposed Plan.
Community Acceptance	This assessment will be performed after comments on the Proposed Plan are received from the public.	This assessment will be performed after comments on the Proposed Plan are received from the public.

ARARs Applicable or Relevant and Appropriate Requirements.
COCs Chemicals of concern.
LUCs Land use controls.
PRGs Preliminary Remedial Goal.
RAOs Remedial Action Objectives.
TBC To Be Considered.

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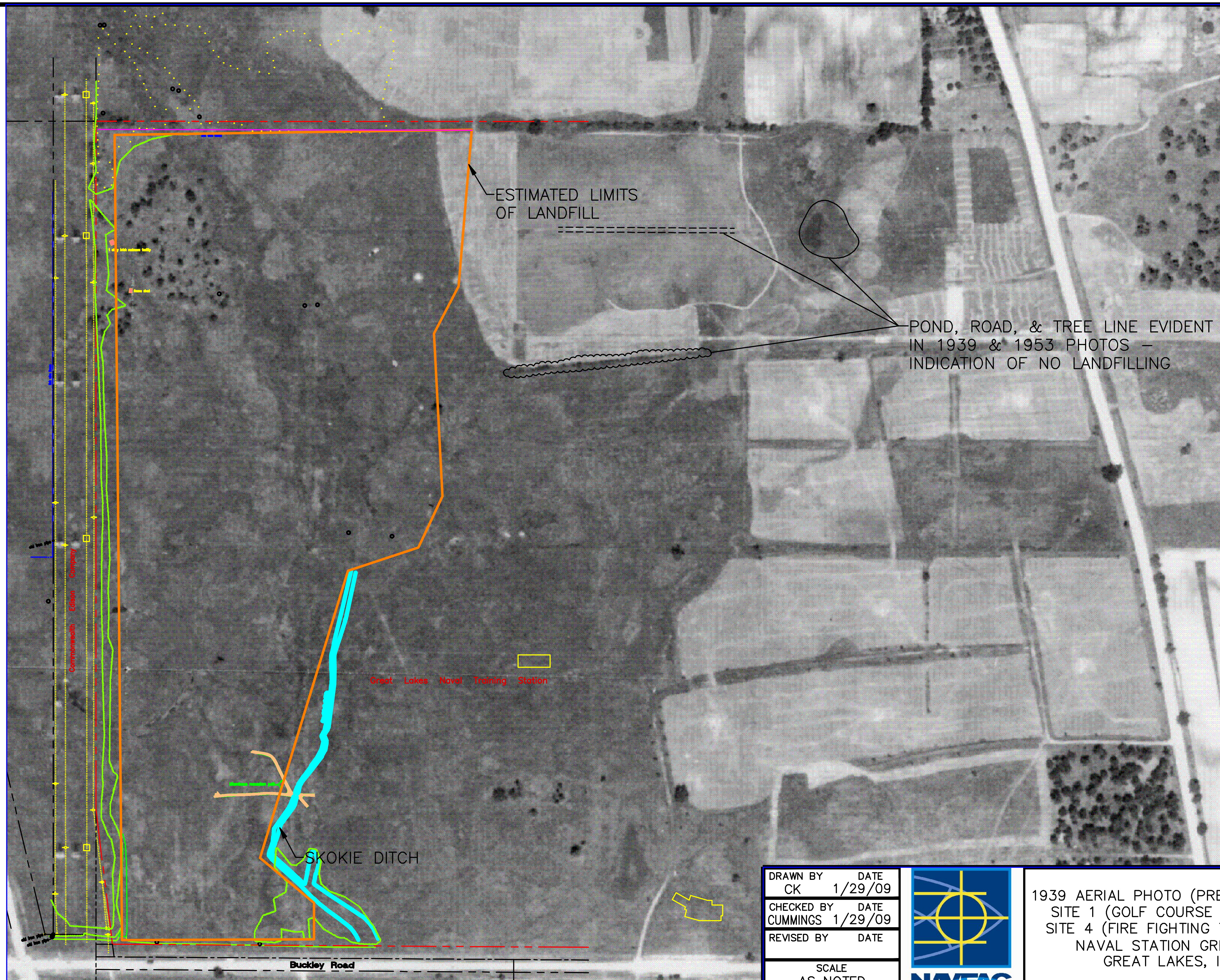
APPENDIX A

HISTORIC LANDFILL INFORMATION



LEGEND

ESTIMATED LIMITS OF LANDFILL

SKOKIE DITCH

DRAWN BY CK DATE 1/29/09	NAVFAC	1939 AERIAL PHOTO (PRE–DEVELOPMENT) SITE 1 (GOLF COURSE LANDFILL) & SITE 4 (FIRE FIGHTING TRAINING UNIT) NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NO. 1314
CHECKED BY CUMMINGS DATE 1/29/09			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1 REV. 0

ACAD:1314CM01.dwg 1/29/09 CK PIT

ACAD: 1314CM02.dwg 1/29/09 CK PIT

LEGEND

- ESTIMATED LIMITS OF LANDFILL
- SKOKIE DITCH

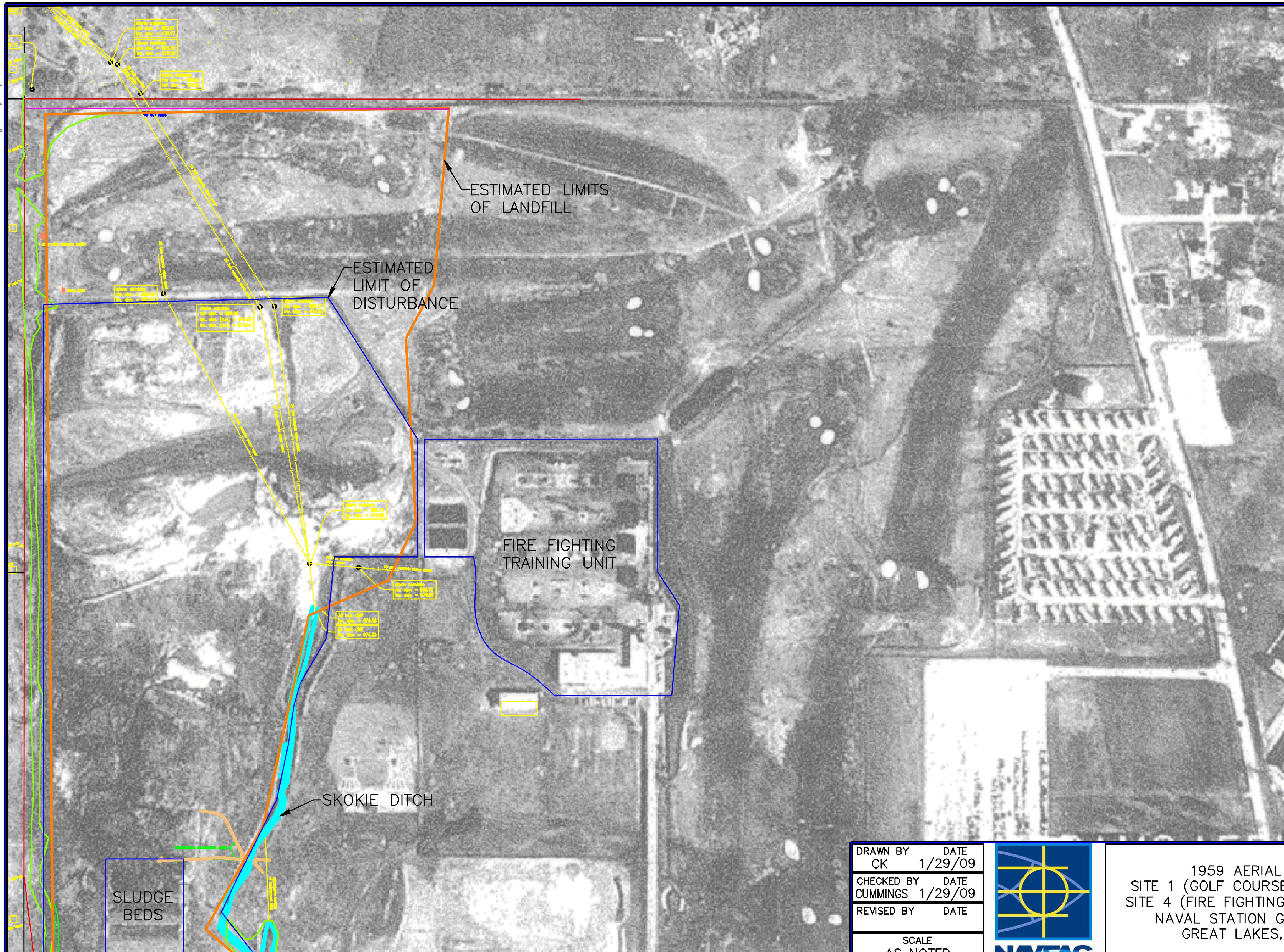
DRAWN BY CK	DATE 1/29/09
CHECKED BY CUMMINGS	DATE 1/29/09
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

1953 AERIAL PHOTO
SITE 1 (GOLF COURSE LANDFILL) &
SITE 4 (FIRE FIGHTING TRAINING UNIT)
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NO. 1314	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 2	REV. 0

ACAD: 1314CM03.dwg 1/29/09 CK PIT



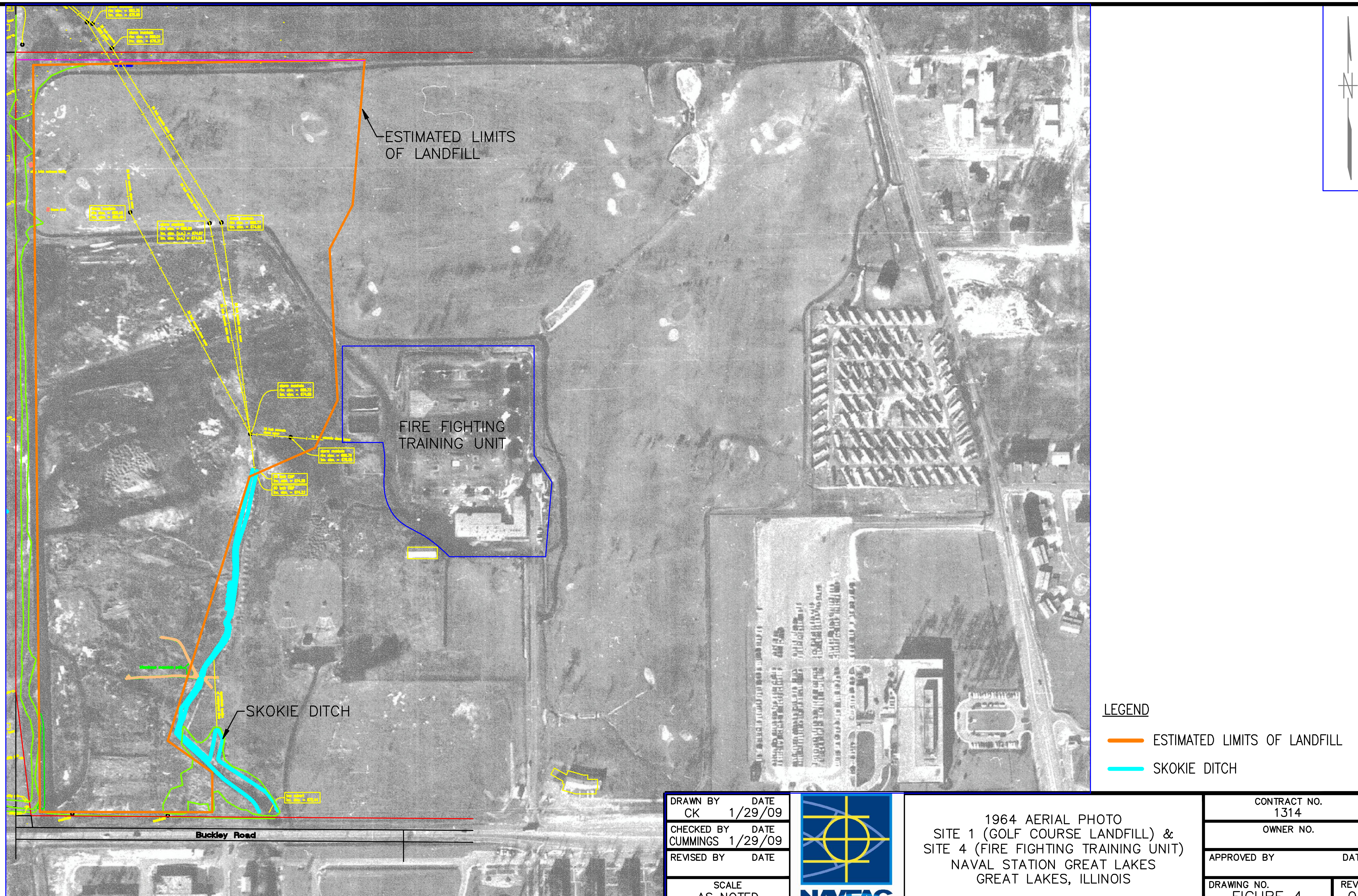
LEGEND

ESTIMATED LIMITS OF LANDFILL

SKOKIE DITCH

DRAWN BY CK / DATE 1/29/09	NAVFAC	1959 AERIAL PHOTO SITE 1 (GOLF COURSE LANDFILL) & SITE 4 (FIRE FIGHTING TRAINING UNIT) NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NO. 1314	
CHECKED BY CUMMINGS / DATE 1/29/09			OWNER NO.	
REVISED BY / DATE			APPROVED BY / DATE	
SCALE AS NOTED			DRAWING NO. FIGURE 3	REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98



ACAD: 1314CM04.dwg 1/29/09 CK PIT

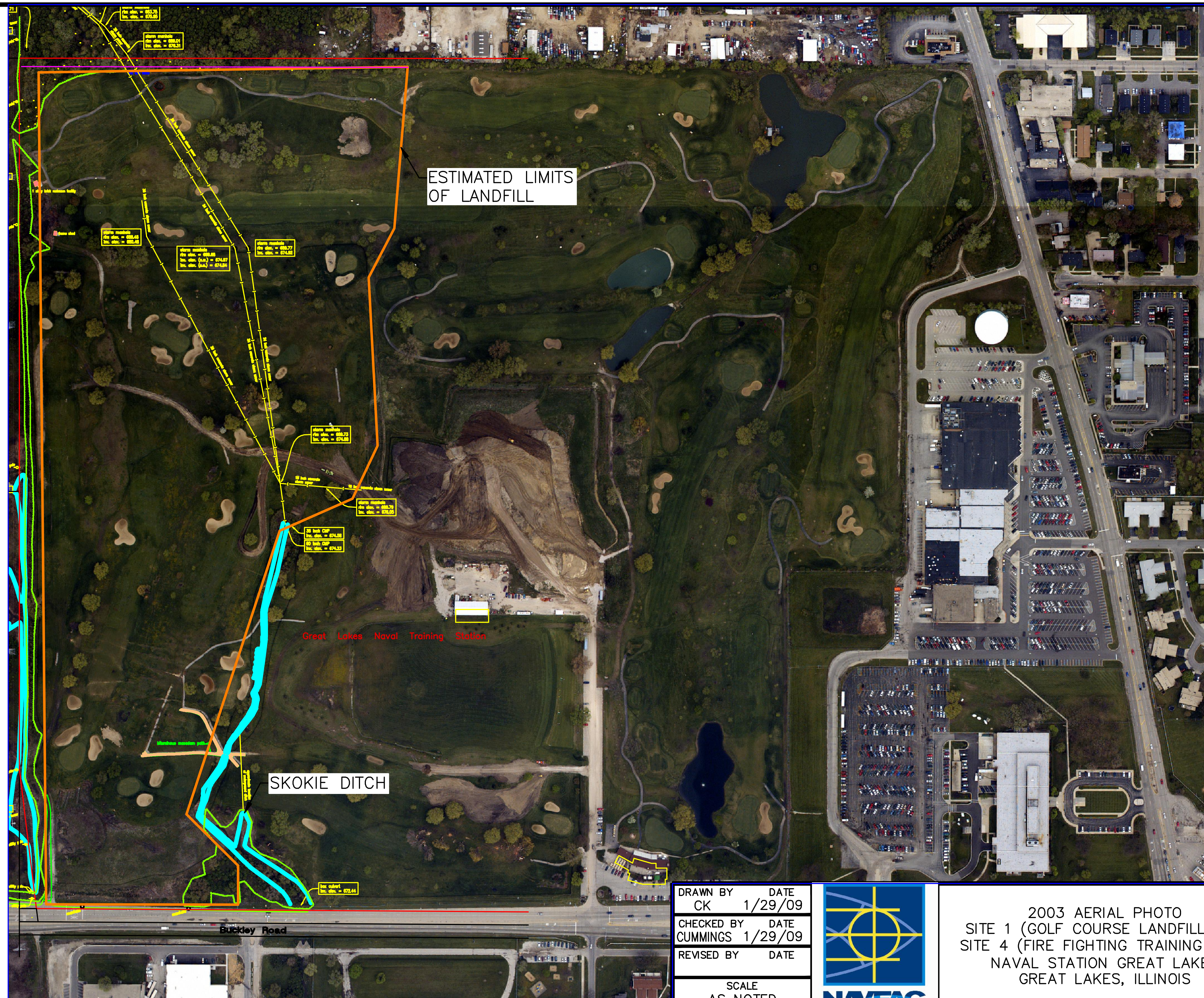
DRAWN BY CK	DATE 1/29/09	
CHECKED BY CUMMINGS	DATE 1/29/09	
REVISED BY	DATE	
SCALE AS NOTED		

NAVFAC

1964 AERIAL PHOTO
SITE 1 (GOLF COURSE LANDFILL) &
SITE 4 (FIRE FIGHTING TRAINING UNIT)
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NO. 1314	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 4	REV. 0

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98



LEGEND

ESTIMATED LIMITS OF LANDFILL

SKOKIE DITCH

DRAWN BY CK DATE 1/29/09	NAVFAC	2003 AERIAL PHOTO SITE 1 (GOLF COURSE LANDFILL) & SITE 4 (FIRE FIGHTING TRAINING UNIT) NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NO. 1314	
CHECKED BY CUMMINGS DATE 1/29/09			OWNER NO.	
REVISED BY DATE			APPROVED BY DATE	
SCALE AS NOTED			DRAWING NO. FIGURE 5	REV. 0

ACAD: 1314CM05.dwg 1/29/09 CK PIT

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

1/13/85

Matt Stahl - 4950

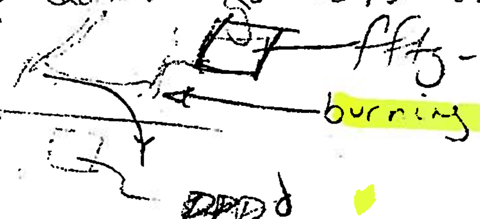
1966 -

19½ yrs was w/ Gr Lks branch - Env. type Dec 69 - May 75

design pre 1970

dump didn't go to rd ~~[illegible]~~ - 1966 to 1970 ish

Golf Course



burning did not x ditch

~~set: phone:~~ Wayne Maver

moved from here to STP area

after Golf Course went away from burning garbage
only dumpster waste (no hsg)

— ? how long behind supply lasted
dug holes to water then backed off a couple of ft. — found a couple of holes

1:00 talk to Bob Riley (ret. wkd for hsg office - was in chg. of landfill)(could tell size of excav.)
689-2674

abandoned area hses were supposed to go on - fnd garbage - dug up a couple of holes

talk to Geo. Young x2309 for oil spills

holes dug ~20' deep x 100'x100' (?)

went to supply to STP. areas for LF

hsg taken to Browning-Ferris landfills (under contract)

Bob Riley - Emerald M/ce
689-2674 1951 →

1/13/85 sea wall - 1941 - junk from old fill exposed 1941-42 when bldg
WWI - burned & covered ~~of~~ garbage w/ cinders (Pwr Plt)
E. of ~~seawall~~ from pwr plnt - to end base all demo deb.
1951-1970
~1966 only ~~junk~~ hauling from inner harbor (bt. basin). 2x to
next to STP
Rifle Range debr. - 1975 → only demol.
- Pettibone Ck - behind 72 (?) concrete only
- btwn McDonald & Lake M. (behind Bldgs (BOQ)"
60" Stm drn 18-20' dn excav filled ~~pea~~ w/ pea gravel
? where empties out
installed late 30s?
- 81 H - incinerator ash dumped ~~used as cover on bldg~~
~~rubble~~ - early WWII, - demo debris
from WWII bldgs w/in last 10 yrs
#106 - used to keep diesel engine in NE corner
& worked on there
~~all flyash~~ cinders (Pwr Plt ~~from RTC~~ trucked to lakefront
WWII - Camp Moffett ravine went through - filled
w/ galley wastes to 18' ± (rd caved in &
dug it out to see how deep)
1954 - std storing coal @ camp Moffett - see sketch
Coal std on top of cliff until add. to BOQ blt (1950s
RTC coal stg (SE corner) early 1950s - 1960s
NW corner of golf cse - burn fill (everything) was
shallow 6-8' burn & cover w/ flyash from pwr
plants daily - was here in 1951 - was
prob. used/started in early 1940s.

did have security problem w/people hauling in & out 4/5

mid late 1960's - 10 yrs worth

6 pits

/13/85 - glf cse - 200' x 100' x 10' deep - bermed
east side of fill area - was used to
disp. of digested sludge from main STP @
lake had drains & gravel btm went to
crk.
accepted everything

barrels
airplanes

Supply landfill 20-25' deep - natural blue
Clay liner ~2 yrs (1968-70)

CBs moved the creek to accomodate hsg area
garbage only S. of VA.
no demolition or hsg wastes, no wood/meta
Barracks, shops, etc.
Supply - 50' x 250' - goes to ~50' of surface drain
Line from RR.
- no L/fill x crk

STP dump - always w/ of tracks

Flourescent tubes - only thing went to "rad"
area - S. of crk was dug up prior
to landfill out there

demol debris - STP S. of RR trcks - , s. of STP
@ ball diamond

4-6' of clay fill hauled in s. of ditch to ball diamond
~1975 stopped trucking sludge to W. STP beds.

✓ Main PP - all steam this side of Green Bay Rd

1968-69 - Closed Plant 58H - (Strictly inside) was coal was oil now gas b/u oil

911 216

all were coal

1211

1711 } beside each - coal hopper in

2011 }

33VA reducing station

✓ 3400 supplies steam always 2 gas boilers oil backup ~~oil~~ ~~coal~~

✓ 3511 was coal fired now gas

✓ 3211 gas was coal

✓ 2711 gas was coal

~~2711 now reserve & pkg liquor - now gas~~

coal - coal piles ash

asbestos logging

machine shop on 2nd floor

(Jimmy Korea)

laboratory wastes

(IKE)

same chemicals in

- Nitromine
- Phosphase
- algaecide ? (IKE) chemist

demineralization IKE ion excha

fluidized bed boiler closed 1½-2 yrs. ago

ran for 2 yr ±

Mike Jamieson

(high sulfur Ill. coal.)

Some remaining contract for coal

1952 golf course l/f to late 60's

all ash to golf course.

excess oil - lab analysis - burned oil w/ #6 in tanks.

#20 300K

11 60K 110K Winter Summer

10 3-4-5 trucks/day winter 2 summer 5cy-8cy/truck

~~3400~~

3511 Chico 4m BTU 6 truckloads/wk - 5cy.

3211 Chico - 20 yd/wk 1711 8 loads/wk

2711 - 8 35 gal/wk

3000 - same as 2800

911 & 1211 - 7-9 trucks/wk each Ill. Chico

most of these by Chico

... during summer

Chico

1/shift - 3-5 gallons

big blowdow 10 gal - 1/day

#boilrs

3511 - 2
3000 - 3
✓ 2600 - 3
✓ 2511 - 2 - old demo
✓ 2711 - 1
3211 - 2
3304 - oil 2
3400 - oil 2
✓ 911 - 4
✓ 1211 - 4
✓ 1711 - 4
✓ 2011 - 3
SBH - 4
✓ 11 - 5 coal 1 oil
Bronson - 7
3011 - 3
3230 - 2

lots of ash used for construction fill all over base.

burn classified documents in regular boilrs

used to burn ~~hosp~~ research waste 3211 SBH + incinerator - all hosp waste.

burn ammo, etc.

10-gallons of fly ash 1 day winter

1971 air atomizers mechanical

used to have hospital research W. of 3211 now housing

Ted Blackwelder

little topsoil on golf course, lot of cinders
- used as cover for dump

Still get methane gas, dumped everything

Dumping before WWII NE corner of golf
course (holes 4 & 5)

? NW

Original 9 holes - defined ~ by fence
along west end of FFTU, dump was west
of there

best soil is on driving range, good soil
N of FFTU

~1 barrel/year

wast engine oil, etc stored in 2-55 gal drums,
brought over to FFTU for disposal
probably dumped along bldg in past →
little grows near bldg

use granular pesticides → fungicide, ~~have been for 6 years or more~~, verly concentrate, 1 herbicide
TRIMEC. 2-5 gal drums

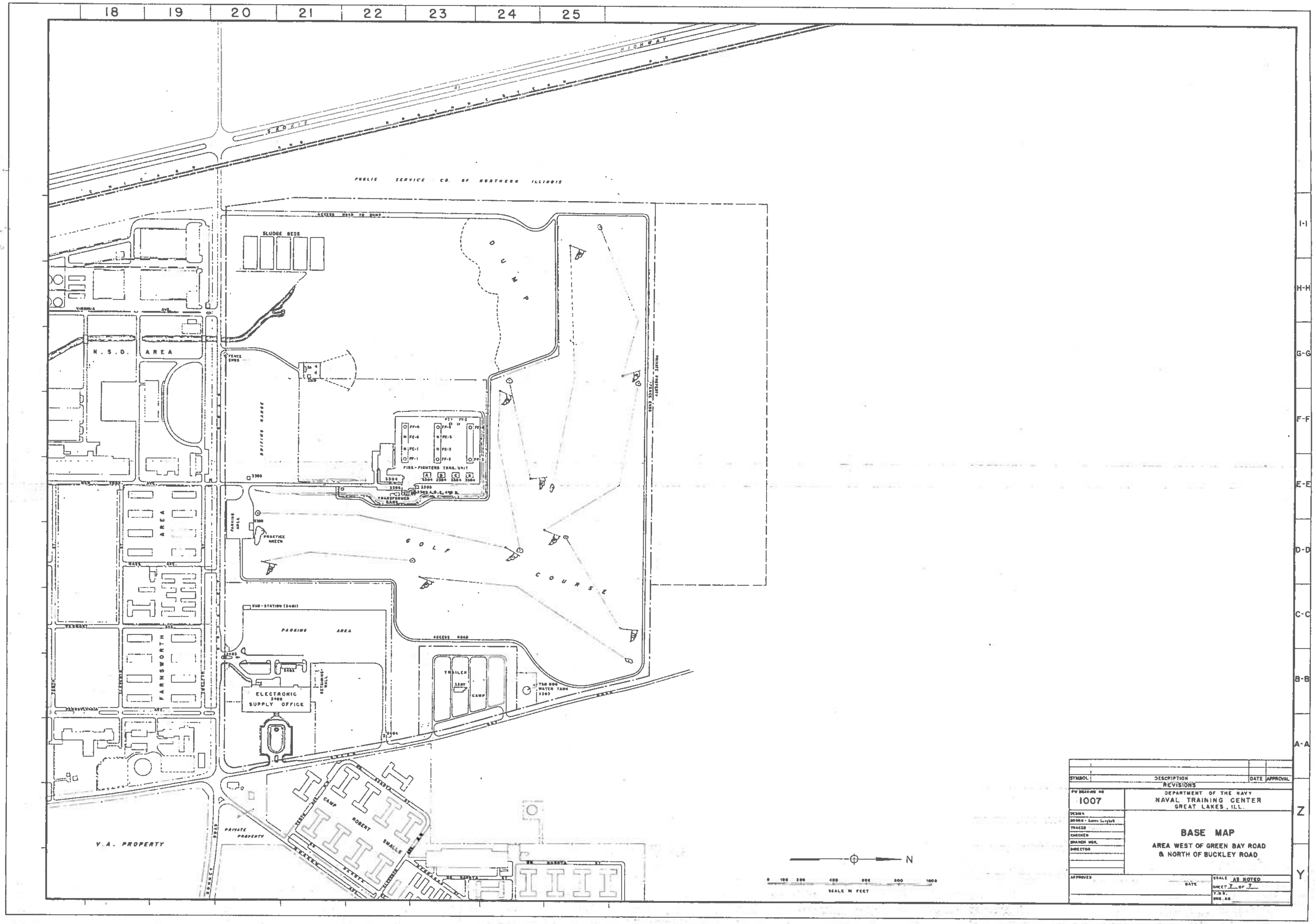
In past, probably mixed pesticides near
sewer drain

went from 9 → 18 holes in 1968
course started before WWII

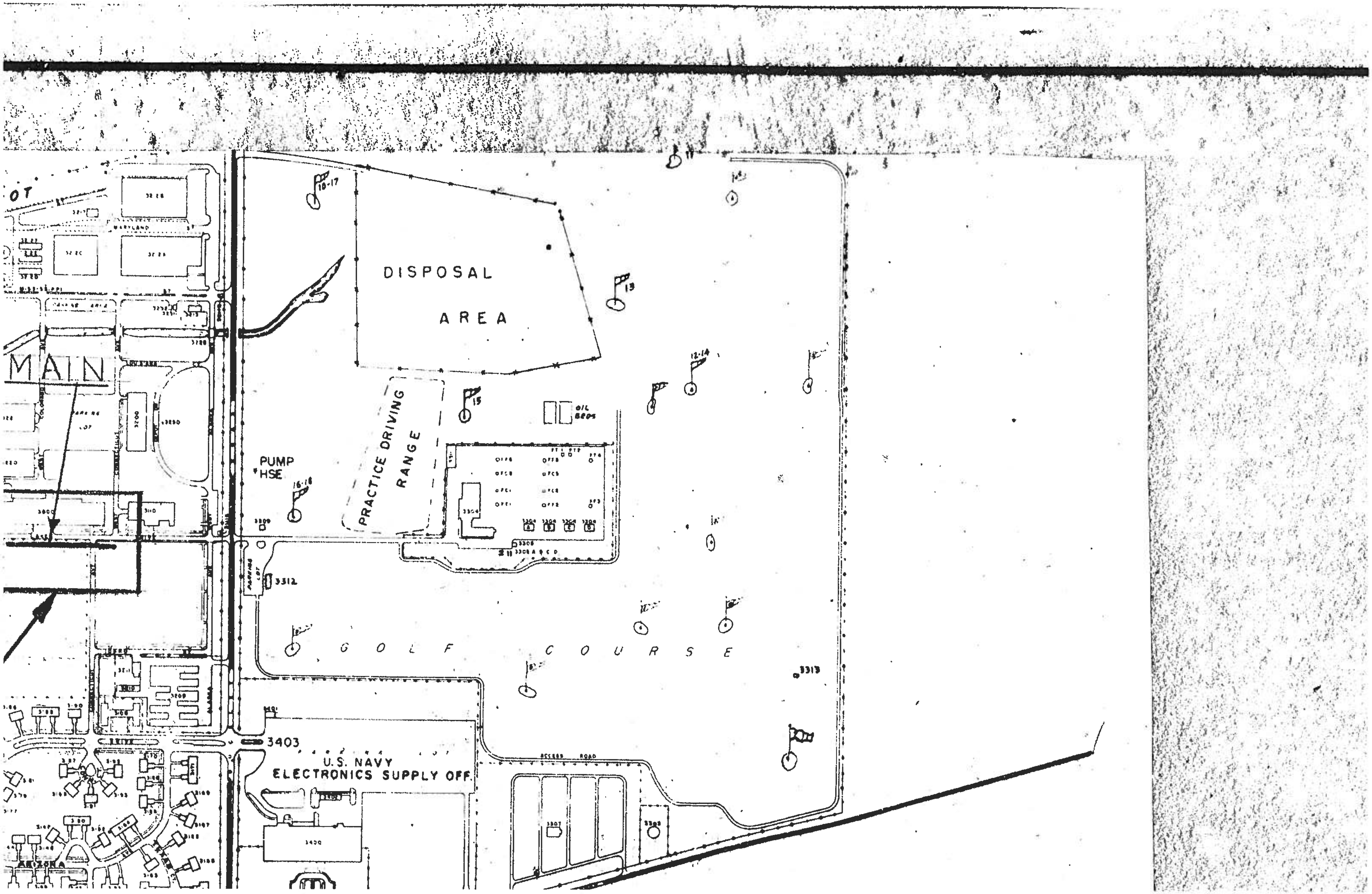
problems with below ground tanks at FFTU,
went to above ground ~ several years ago

Abbott spill ~2-3 years ago

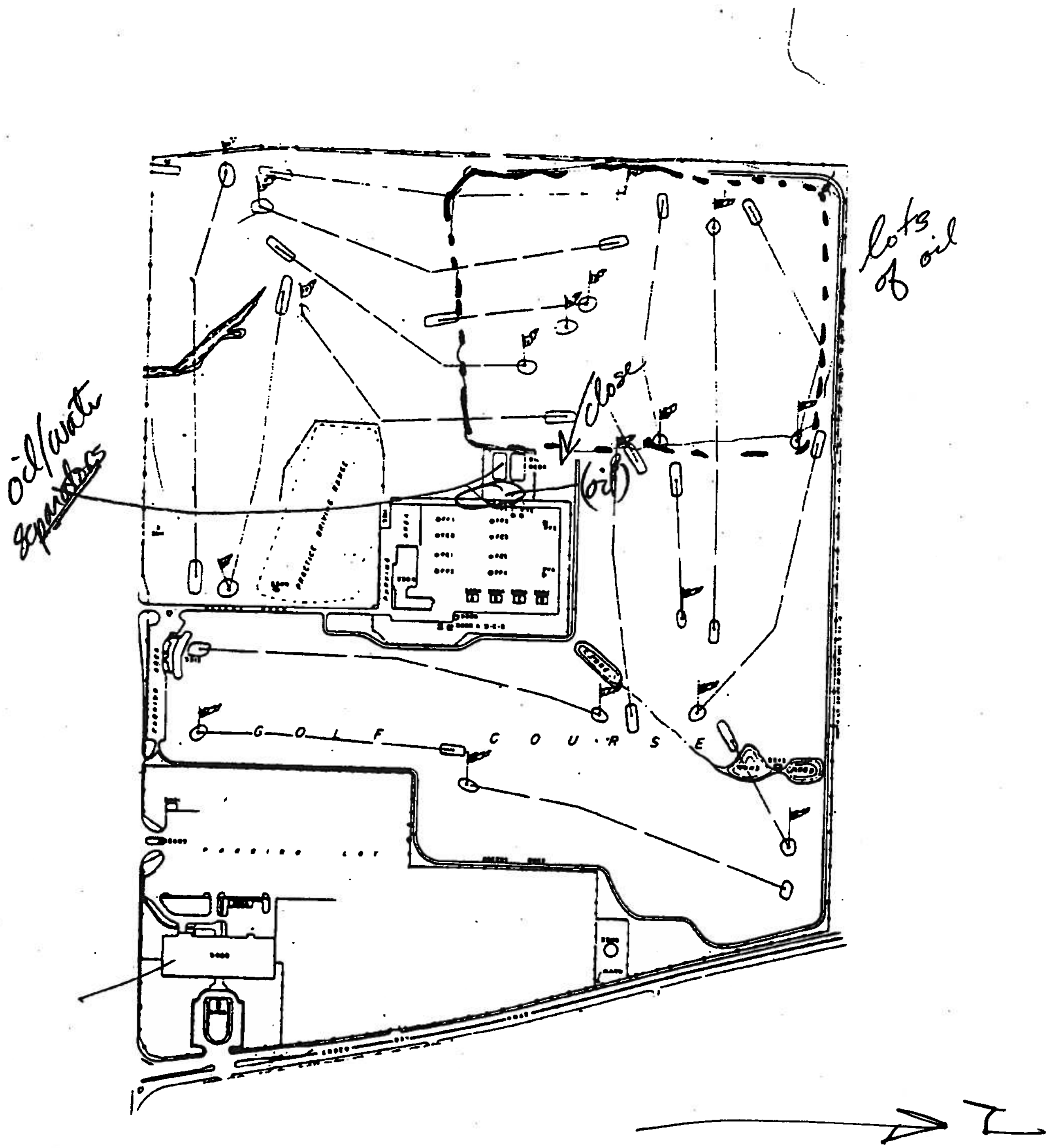
Waste pits at FFTU; little spill in heavy rain
2-3 years ago, cleaned out separating pits


18
19
20
21
22
23
24
25
I-I
H-H
G-G
F-F
E-E
D-D
C-C
B-B
A-A
Z
Y
PUBLIC SERVICE CO. OF NORTHERN ILLINOIS
SLUDGE BEDS
DUMP
N.S.D. AREA
DRIVING RANGE
FIRE-FIGHTERS TRNG. UNIT
TRANSFORMER BANK
PARKING AREA
PRACTICE GREEN
GOLF COURSE
FARNSWORTH AREA
SUB-STATION (3401)
PARKING AREA
ACCESS ROAD
TRAILER CAMP
750 000 WATER TANK 3303
ELECTRONIC SUPPLY OFFICE
V.A. PROPERTY
PRIVATE PROPERTY
CAMP ROBERT SMALLE
N
SCALE IN FEET
SYMBOL
DESCRIPTION
DATE
APPROVAL
REVISIONS
1007
DEPARTMENT OF THE NAVY
NAVAL TRAINING CENTER
GREAT LAKES, ILL.
DESIGN
TRACED
CHECKED
DIRECTOR
BASE MAP
AREA WEST OF GREEN BAY ROAD
& NORTH OF BUCKLEY ROAD
APPROVED
DATE
SCALE AS NOTED
SHEET 7 OF 7

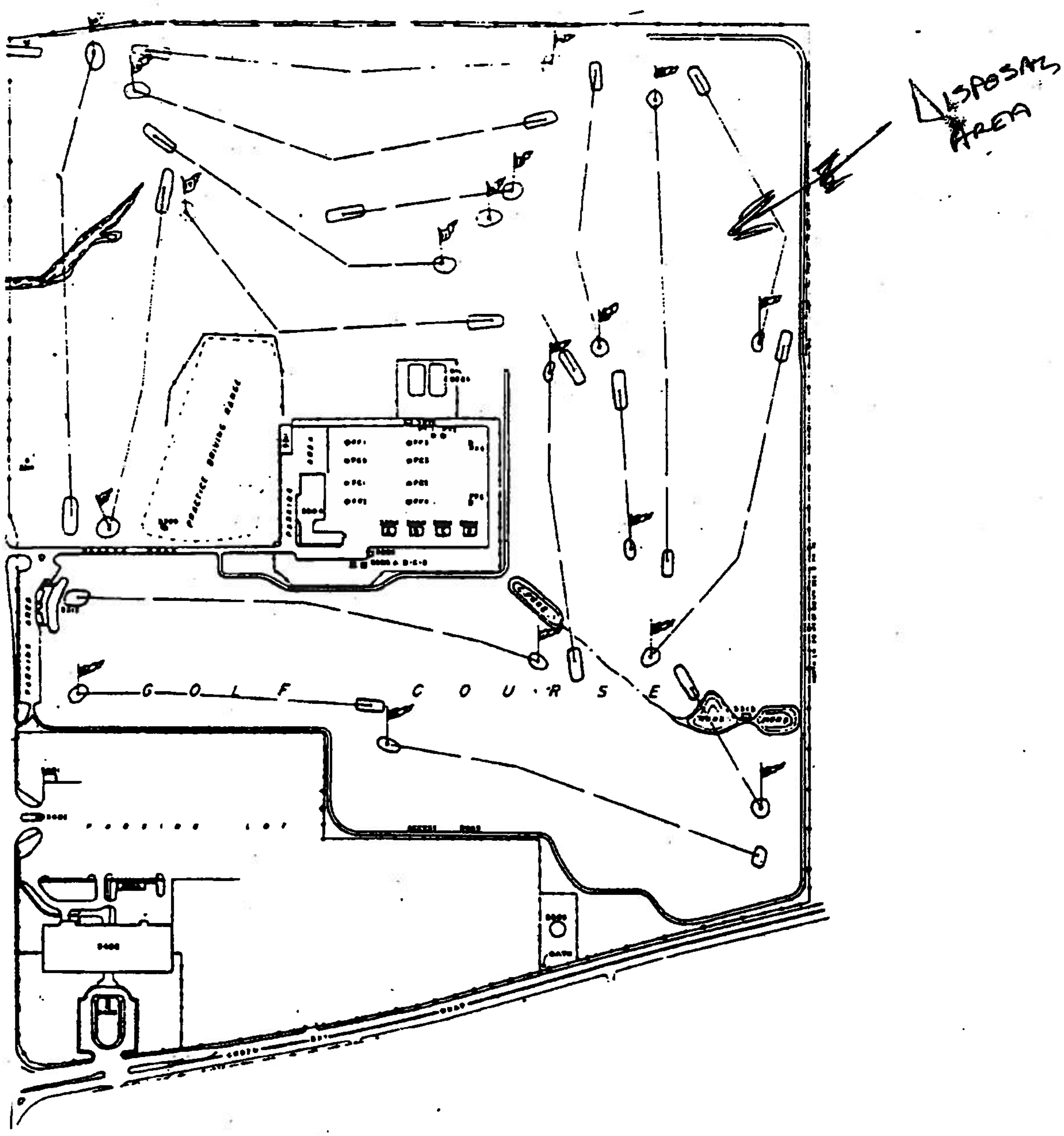
957

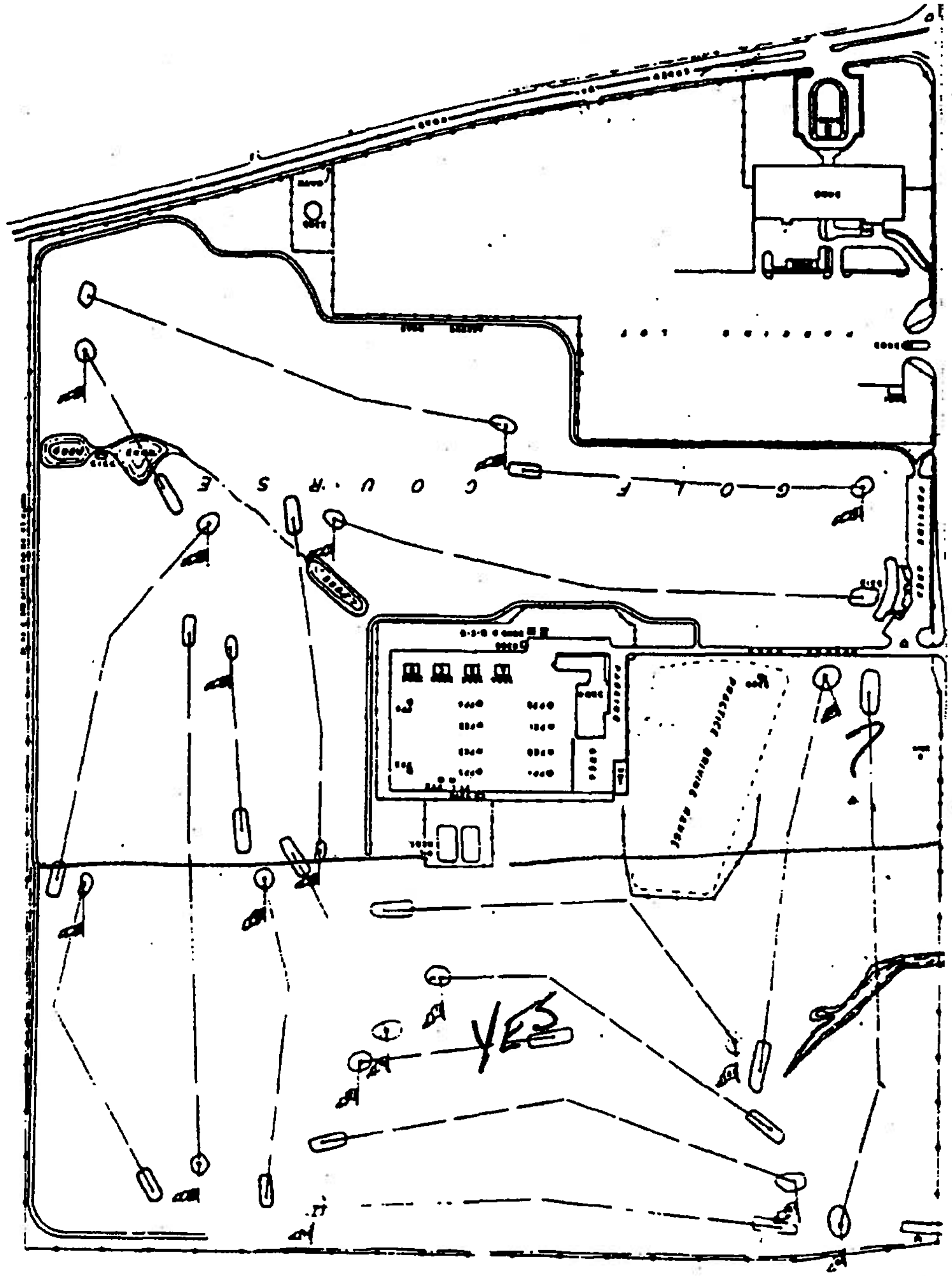


DISPOSAL
AREA
PRACTICE DRIVING RANGE
PUMP HSE
MAIN
G O L F C O U R S E
3312
3313
3403
U.S. NAVY
ELECTRONICS SUPPLY OFF.



lots of oil
close
(oil)
oil/water separators
PRACTICE DRIVING RANGE
G O L F C O U R S E
PARKING LOT


DISPOSAL AREA
G O L F C O U R S E


GOLF COURSE
YES
7

APPENDIX B

TECHNICAL MEMORANDUM

TETRA TECH

TECHNICAL MEMORANDUM – SKOKIE DITCH EVALUATION

Subject: **Analysis of Alternatives - Skokie Ditch Repair/Relocation**
CTO 506

Date: December 19, 2008

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1 Introduction

1.1 Purpose of Memorandum

The purpose of this Technical Memorandum is to present an analysis of alternatives addressing deteriorated conditions of two storm sewers that are part of the Skokie Ditch infrastructure.

This evaluation was prepared under Contract Task Order 506 of the Comprehensive Long-Term Environmental Action Navy IV, Contract Number N62467-04-D-0055 in conjunction with the Focused Feasibility Study (FFS) for Site 1, Golf Course Landfill (aka Willow Glen Golf Course) at the United States (U.S.) Naval Station Great Lakes located in Lake County, Illinois.

The Navy conducted the Site 1 FFS with a team including representatives from the Illinois Environmental Protection Agency (Illinois EPA), Naval Facilities Engineering Command (NAVFAC) Midwest and the Navy's consultant, Tetra Tech NUS, Inc. (TtNUS). The Statement of Work for the FFS requested identification of possible replacement alternatives for the deteriorated portion of the Skokie Ditch drainage system to address potential risks at Site 1. The selected remedy will be determined based on an evaluation of the alternatives compared to their effectiveness, implementability, and cost.

1.2 Site Background

Site 1, Willow Glen Golf Course Landfill, is a 125-acre site located at the northwestern corner of Naval Station Great Lakes (Figure 1-1). The landfill was operated between 1942 and 1967 as a trench/burn operation for an estimated 1.5 million tons of material. Types of wastes reportedly included domestic refuse, sewage sludge, petroleum, oil,lubricants, solvents, coal ash, and materials contaminated by polychlorinated biphenyls (PCBs). Landfill waste is located under the fairways, greens, and tees of at least 12 holes of the present golf course.

Most surface and shallow groundwater at Site 1 drains to the Skokie Ditch. The Skokie Ditch is a perennial stream that originates somewhere northwest of Site 1 and travels via an underground storm sewer until it surfaces in the middle of Site 1. The Skokie Ditch flows south from the site, passing the Supply Side area of the base and exiting Navy property after passing the Green Bay Sewage Treatment Plant in Forrestal Village. From there, the Skokie Ditch becomes the Skokie River, which eventually discharges into the Chicago River. The Skokie Ditch is a sluggish, almost stagnant, stream in the area of Site 1, except for immediately following storms.

The current Skokie Ditch infrastructure (storm sewer pipes), located in an easement within the limits of Site 1, is in a deteriorated condition based on the collapse/sinkholes that occurred in 2003. The Navy is also concerned about additional collapses or a catastrophic failure that may cause waste materials from the landfill to enter Skokie Ditch and migrate off site. This is in addition to the possibility of groundwater from the landfill infiltrating into the system. To mitigate these potential problems, the Navy has identified five options within three alignments for the Skokie Ditch infrastructure repair, replacement, and/or relocation. The five options are presented in more detail in Section 2.0, along with discussions regarding the alternative alignments.

1.3 Site Investigation

A Remedial Investigation (RI)/Risk Assessment (RA) was completed for Site 1 in March 2008. The investigation provided site-wide data on select organic and inorganic chemical concentrations in sediment, surface water, and groundwater to evaluate risks to human health and the environment. Additionally, the investigation provided data on select organic and inorganic chemical concentrations in subsurface soil related to the Skokie Ditch infrastructure relocation.

The results from the sampling and laboratory analysis are provided in the RI/RA (TtNUS, March 2008). A summary of these results specific to the possible alternatives for the replacement of the Skokie Ditch infrastructure relocation is provided in Section 2.2 below.

2 Skokie Ditch Options

The following sections provide brief discussions of the options and their related alignments for addressing the Skokie Ditch infrastructure relocation/repair. It includes discussions regarding the option alignments, the investigation performed, conditions along the alignments, and the specific elements of each option.

2.1 Alignments

Five options were developed to address deteriorated conditions of two storm sewers that are part of the Skokie Ditch infrastructure. Each option is included within one of three alignments, existing, middle, or southern. These three alignments, which were developed in conjunction with the Skokie Drainage District, and their associated options are discussed below and are shown on Figure 2-1.

2.1.1 Option 1 (a, b, and c)

Option 1, which has three variations, (a, b, and c) follows the current route. The three variations for this option are defined as “a,” “b,” and “c.” **Option 1a** involves excavating the soil and waste from above the pipes, removing/replacing the pipes, and backfilling. **Option 1b** involves excavating the soil and waste from above the pipes, removing the current infrastructure, and leaving the ditch as an open channel. **Option 1c** involves performing an in-situ replacement of the existing pipelines through a relining process.

2.1.2 Option 2

Option 2 follows the middle route. This route traverses the western boundary of the golf course and, approximately 1600 feet north of Buckley Road, diverges east to connect to the existing route where the buried Skokie Ditch pipes daylight. Option 2 involves rerouting and replacing the current infrastructure along the middle route. The existing damaged pipes would be grouted closed with lean concrete to minimize additional failures and infiltration from the landfill.

2.1.3 Option 3

Option 3 follows the southern route. This route traverses the western boundary of the golf course and, approximately 400 feet north of Buckley Road, diverges east to connect with the Skokie Ditch approximately 400 feet before it flows under Buckley Road. Option 3 involves rerouting and replacing the current infrastructure along the southern route. As with Option 2, the existing damaged pipes would be grouted closed with lean concrete.

2.2 Investigations and Site Conditions

Investigations were performed during the RI/RA to help identify environmental conditions along each of the three options and their respective alignments. This information was used in the analysis of the options and aided in defining construction efforts, risks (to workers and related to future environmental liabilities), soil management requirements, and overall effectiveness, implementibility, and cost. This section presents a brief summary of the investigations performed and conditions encountered along the alignments of each option.

2.2.1 Options 1a, 1b, and 1c

Nine subsurface soil samples were collected in the area of the current route to characterize the materials that would be excavated to replace the culverts under these options, with sample depths ranging from 7 to 8 feet to 15 to 16 feet below ground surface. The analysis of these samples indicated that concentrations of polynuclear aromatic hydrocarbons (PAHs) and lead exceeded human health criteria (either Illinois Environmental Protection Agency [EPA] tiered approach to corrective action objectives [TACOs] or U. S. EPA Region 9 preliminary remediation goals [PRGs]) in five of the nine samples. Visual observations of the soil during the drilling and sampling process indicated that landfill waste materials were located from between 4 to 7 feet to 19 to 22 feet below ground surface.

2.2.2 Option 2

Sixteen soil borings were drilled along the middle route to determine if landfill waste materials were present. Twelve soil borings were drilled along the proposed north-south location to delineate the horizontal extent (western boundary) of the landfill. Visual observations of the soil from these borings indicated that natural soil (sand, silty clay, and clay) with occasional ash was present. No samples of the natural soil were collected for laboratory analysis. Four soil borings were drilled along the proposed east-west location of this alternative and four samples were collected at depths of 3 to 4 feet to 15 to 16 feet below ground surface to characterize the materials that would be excavated to install the culverts. The analysis of these samples indicated that concentrations of PAHs and lead exceeded human health criteria (either Illinois EPA TACOs or EPA Region 9 PRGs) in three of the four samples. Visual observations of the soil during the drilling and sampling process indicated landfill waste materials were in two of the soil borings, and there were signs of ash, glass, and metal in the other two borings.

2.2.3 Option 3

Twenty-seven soil borings were drilled along the southern route to determine if landfill waste materials were present. Twenty-four of the borings were drilled along the north-south location to delineate the horizontal extent (western boundary) of the landfill. Visual observations of the soil from these borings indicated that natural soil (sand, silty clay, and clay) with occasional ash was present. No samples of the natural soil were collected for laboratory analysis. Three soil borings were drilled along the proposed east-west location of this alternative, and three soil samples were collected at depths of 4 to 6 feet to 18 to 19 feet below ground surface. These samples were collected to characterize the materials that would be excavated to install the pipes. The analysis of these samples did not indicate exceedances of human health criteria (either Illinois EPA TACOs or EPA Region 9 PRGs) in the samples. Visual observations of the soil from these borings during the drilling and sampling process indicated natural soil (sand, silty clay, and clay).

2.3 Discussion of Options

The following sections provide brief discussions of the options and include a summary of the specific tasks associated with each.

2.3.1 Option 1a

Option 1a would include the following tasks:

- Excavation of materials above the existing Skokie Ditch infrastructure (pipes)
- Material transportation and disposal
- Removal and replacement of the existing Skokie Ditch infrastructure (pipes)
- Backfilling of the excavations to the current grades
- Reseeding of disturbed areas

The excavation to access the two damage pipes would be 1,600 feet long, average 16 feet deep, and be approximately 10 feet wide at the base. A trench box would be used to reduce excavation and waste volumes. The total excavation is estimated to produce 19,000 cubic yards of material. This material would be both soil and waste materials and would be disposed as non-hazardous waste at a local off-site landfill.

Upon completion of the soil excavation, the damaged pipe systems would be excavated and replaced with two 30-inch-diameter reinforced concrete pipes (each 1,600 feet long). The trench would then be backfilled with approximate 19,000 cubic yards of fill to match the surrounding grade. The final surface (approximate 1.5 acres) would then be seeded and mulched to re-establish the grass cover.

2.3.2 Option 1b

Option 1b would include the following tasks:

- Excavation of materials above the existing Skokie Ditch infrastructure (pipes)
- Material transportation and disposal
- Removal of the existing Skokie Ditch infrastructure (pipes) and grading
- Placement of riprap
- Reseeding of ditch slopes

The excavation to access the damaged pipes would be 1,600 foot long, average 16 feet deep, and be approximately 50 feet wide at the base. With uniform side slopes (2H:1V), the top width of the excavation would be approximately 115 feet. The total excavation is estimated to produce 68,500 cubic yards of material. This material would be both soil and waste materials and would be disposed as non-hazardous waste at a local off-site landfill.

Upon completion of the soil excavation, the damaged pipe systems would be removed, and the base of the excavation would be graded to form an open channel. Riprap would then be placed at the flow line of the channel sides, and the slopes would be seeded and mulched to re-establish the grass cover.

2.3.3 Option 1c

Option 1c would involve in-situ replacement of the damaged pipes through a process known as pipe bursting and would include the following tasks:

- Excavation of pits for pipe access and anchor installation
- Material transportation and disposal
- Pipe bursting and pipe replacement
- Backfilling of pits
- Reseeding of disturbed areas

This work would be conducted by a specialty contractor. The pipe bursting process is a method by which the existing pipe is forced outward and opened by a bursting tool. The existing pipe is used as a guide for inserting the bursting tool's expansion head. The expansion head is pulled through the existing pipe with a steel line, increasing the area available for the new pipe by pushing the existing pipe outward until it cracks. The steel line, connected to a constant-tension winch, is connected to the tool from the exit manhole (or other opening) at the end of the pipe section. The new pipe is connected to the back of the tool and is pulled through, along with the tool. This process can utilize existing manholes as points of entry or require the excavation of pits to serve as access points. Typically, the repair length is limited to 300-foot sections.

Under Option 1c, pits would be excavated every 300 feet along each of the two existing 1,600-foot segments of damaged pipe, producing an estimated 5,000 cubic yards of spoil. This material would include both soil and waste materials and would be disposed as non-hazardous waste at a local off-site landfill. As part of the process, the pipe would be broken and replaced with an approximately 30-inch-diameter high density polyethylene (HDPE) pipe. Following installation of the new pipe, the pits would be backfilled to the original ground level and the disturbed surface would be reseeded.

2.3.4 Option 2

Option 2 would involve the relocation of the Skokie Ditch infrastructure to the middle route and would include the following tasks:

- Excavation of trench materials along the Middle route
- Material transportation and disposal
- Installation of two 30-inch-diameter reinforced concrete (RC) pipes
- Backfilling of the excavations to current grades
- Reseeding of disturbed areas
- Grouting of existing pipes

Pipes would be installed in a single trench that would be approximately 2,200 feet long, have an average depth of 15 feet deep, and be approximately 15 feet wide at the base. A trench box would be used in the excavation to minimize the volume of material removed. The total excavation is estimated to produce 18,000 cubic yards of material. Excavated soil along the north-south location (approximately 10,500 cubic yards) is assumed to be clean and would be used to backfill the excavation, and approximately 7,500 cubic yards of both soil and waste materials would be disposed as non-hazardous waste at a local off-site landfill.

Upon completion of the trench excavation, the pipe placement would occur, which would include installation of bedding and placement of two 30-inch-diameter RC pipes (each approximately 2,200 feet long). The trench would be backfilled with approximately 18,000 cubic yards of fill to match the surrounding grade. The final surface (approximate 1 acre) would then be seeded and mulched to re-establish the grass cover.

Upon completion, the damaged existing pipes would be capped at the ends and filled with lean concrete grout.

2.3.5 Option 3

Option 3 would involve the relocation of the Skokie Ditch infrastructure to the southern route and would include the following tasks:

- Excavation of trench materials along the southern route
- Material transportation and disposal
- Installation of two 30-inch-diameter RC pipes
- Backfilling of the excavations to current grades
- Reseeding of disturbed areas
- Grouting existing pipes in-place

Pipes would be installed in a single trench that would be approximately 3,000 feet long with an average depth of 12 feet and an average width of approximately 15 feet at the base. A trench box would be used in the excavation to minimize the volume of material removed. The total excavation is estimated to produce 20,000 cubic yards of materialthat is assumed to be clean and would be used to backfill the excavation. Any excess material would be hauled off-site.

Upon completion of the trench excavation, the pipe placement would occur, which would include installation of bedding, and placement of two 30-inch-diameter RC pipes each approximately 3,000 feet long. The trench would then be backfilled with approximate 20,000 cubic yards of fill to match the surrounding grade. The final surface (approximate 1.5 acres) would then be seeded and mulched to re-establish the grass cover.

Upon completion, the damaged existing pipes would be capped at the ends and filled with lean concrete grout.

3 Analysis of Alternatives

3.1 Criteria

The criteria used to evaluate the alternatives include effectiveness, implementability, and cost. Effectiveness is a gauge of the option’s capacity to be protective of human health and the environment; reduction in toxicity, mobility, or volume of waste; and permanence of the solution. For this assessment, the following effectiveness factors were considered: risk of worker exposure; risk of accidental discharges; assessment of future risks relative to potential exposure pathways; and future liabilities. Implementability is a gauge of the option’s technical and administrative feasibility along with special long-term considerations such as operation and maintenance. For this assessment, the following implementability factors were considered: need for easements; material disposal requirements (which greatly impact costs); feasibility of the option to be implemented and meet the design needs; and need for future activities. The cost estimates for each option are qualitative and provide estimates of capital expenditures to implement the option. The estimates are based on rough quantity estimates.

3.2 Option 1a – Excavate and Replace Existing Pipes

This option consists of excavating the existing pipes and replacing in kind with two 30 inch reinforced concrete pipes.

3.2.1 Effectiveness

As a measure of effectiveness, or lack of, this option would;

- Provide high risk for worker exposure
- Provide high risk for accidental releases during construction activities
- Not remove potential pathways, and therefore would not eliminate potential future environmental risks
- Maintain continued future Navy liability
- Not eliminate the potential need for future actions in the contaminated area

3.2.2 Implementability

As a measure of implementability, or lack of, this option would;

- Likely require future maintenance
- Require disposal of 28,500 tons of contaminated soil
- Require a continued easement through the landfill

3.2.3 Cost

The estimated capital cost for this option, as presented in Table 1a, is $2,800,000.

3.3 Option 1b - Excavate Existing Pipes and Leave as Open Channel

This option consists of excavating contaminated cover soil and the existing pipes, disposing the excavated materials as waste, and then leaving the excavation as an open channel ditch.

3.3.1 Effectiveness

As a measure of effectiveness, or lack of, this option would;

- Provide high risk for worker and recreational user exposure
- Provide high risk for accidental releases during construction activities
- Not remove potential pathways, and therefore would not eliminate potential future environmental risks

- Allow for exposure of waste and discharges directly into the ditch (i.e., leaching of waste into open channel)
- Maintain continued future Navy liability
- Not eliminate the potential need for future actions in the contaminated area

3.3.2 Implementability

As a measure of implementability, or lack of, this option would;

- Likely require future maintenance
- Require disposal of 103,000 tons of contaminated soil
- Require a continued easement through the landfill

3.3.3 Cost

The estimated capital cost for this option, as presented in Table 1b, is $7,500,000. The major cost driver for this option is material disposal.

3.4 Option 1c – Reline Existing Pipes

This option consists of relining the existing pipes in-situ using excavated pits to provide access.

3.4.1 Effectiveness

As a measure of effectiveness, or lack of, this option would;

- Minimize worker exposure
- Minimize risk for accidental releases during construction activities
- Not remove potential pathways, and therefore would not eliminate potential future environmental risks
- Maintain continued future Navy liability

3.4.2 Implementability

As a measure of implementability, or lack of, this option would;

- Be of limited viability if the existing pipes are severely damaged
- Require disposal of 7,500 tons of contaminated soil
- Be the quickest to implement
- Likely require future maintenance
- Likely decrease pipe flow capacities
- Require a continued easement through the landfill

3.4.3 Cost

The estimated capital cost for this option, as presented in Table 1c, is $2,500,000.

3.5 Option 2 - Re-Route Pipes through Middle Route

This option consists of installing an in-kind system consisting of two 30 inch reinforced concrete pipes along the west side of the property and connecting to the open ditch in the middle of the golf course. This option also includes sealing the existing pipes by capping both ends and grouting them full.

3.5.1 Effectiveness

As a measure of effectiveness, or lack of, this option would;

- Lower worker exposure compared to Options 1a and 1b but have greater risks than Option 3 (southern route)
- Only partially remove potential pathways since piping will still intercept waste, and would not eliminate potential future environmental risks
- Maintain continued future Navy liability
- Not eliminate the potential need for future actions in contaminated

3.5.2 Implementability

As a measure of implementability, or lack of, this option would;

- Likely require future maintenance
- Require disposal of 11,250 tons of contaminated soil
- Require a limited easement through the landfill

3.5.3 Cost

The estimated capital cost for this option, as presented in Table 2, is $1,800,000.

3.6 Option 3 - Re-Route Pipes through Southern Route

This option consists of installing an in-kind system consisting of two 30 inch reinforced concrete pipes along the west side of the property and connecting to the open ditch at the southern end of the golf course. This option also includes sealing the existing pipes by capping both ends and grouting them full.

3.6.1 Effectiveness

As a measure of effectiveness, or lack of, this option would;

- Eliminate/minimize worker exposure to contaminated soil
- Eliminate/minimize risk of accidental releases during construction activities
- Eliminate potential pathways
- Eliminate future actions in contaminated area since piping will not intercept waste
- Minimize future Navy liability

3.6.2 Implementability

As a measure of implementability, or lack of, this option would;

- Require less future maintenance when compared to the other options
- Not require an easement through the landfill
- Not require disposal of contaminated soil

3.6.3 Cost

The estimated capital cost for this option, as presented in Table 3, is $1,400,000.

4 Conclusions and Recommendations

Option 3 is the preferred solution. This option involves the replacement of the current infrastructure along the southern route, which traverses the western side of the property and connects to the open ditch at the southern end of the golf course. It also includes closure of the existing damaged pipes through the placement of lean concrete grout. Through use of the southern route, Option 3 skirts the landfill limits avoiding excavation and disposal of impacted material. Avoiding the landfill enables this option to:

- Minimize worker exposure during construction
- Eliminate direct access to exposure pathways, therefore lowering future exposure risks
- Eliminate the potential for releases to waters of the state
- Remove the Skokie Drainage easement from the contaminated landfill area
- Minimize current and future Navy liability

This option also has the lowest estimated cost.

Table 1a
Analysis of Alternatives
Skokie Ditch Repair/Relocation

Option 1a - Excavate and Replace Pipe - Excavate using Trench Box

Item	Quantity	Unit	Unit Cost	Total Cost	
Mobilization	1	LS	$60,000.00	$60,000.00	
Excavation	19000	CY	$3.60	$68,400.00	use 10 ft trench width for vol calcs
Pipe Bedding	3200	LF	$45.00	$144,000.00	
Pipe	3200	LF	$75.00	$240,000.00	
Backfill	18000	CY	$10.50	$189,000.00	
Compaction	19000	CY	$2.00	$38,000.00	
Top Soil	2400	CY	$20.00	$48,000.00	
Grass/Hydroseed	65000	1000 SF	$100.00	$6,500.00	
Nonhazardous Disposal	28500	TON	$50.00	$1,425,000.00	
Additional Costs*	1	LS	$554,725.00	$554,725.00	
Total				**$2,800,000.00**	

* - Additional costs include erosion & sedimentation controls, permits, supervision, engineering, pumping/disposal of water, etc.

Table 1b
Analysis of Alternatives
Skokie Ditch Repair/Relocation

Option 1b - Excavate Existing Pipe and Leave as Open Channel

Item	Quantity	Unit	Unit Cost	Total Cost
Mobilization	1	LS	$60,000.00	$60,000.00
Excavation	68500	CY	$3.60	$246,600.00
Rip Rap	4000	SY	$85.00	$340,000.00
Top Soil	8000	CY	$20.00	$160,000.00
Grass/Hydroseed	196000	1000 SF	$100.00	$19,600.00
Nonhazardous Disposal	103000	TON	$50.00	$5,150,000.00
Additional Costs*	1	LS	$1,494,050.00	$1,494,050.00
Total				**$7,500,000.00**

* - Additional costs include erosion & sedimentation controls, permits, supervision, engineering, pumping/disposal of water, etc.

Table 1c
Analysis of Alternatives
Skokie Ditch Repair/Relocation

Option 1c - Pipe Bursting/Reline Existing Pipes

Item	Quantity	Unit	Unit Cost	Total Cost	
Mobilization	1	LS	$100,000.00	$100,000.00	
Excavate Pit & Return to Original	5000	CY	$12.00	$60,000.00	Requires excavation at 300 ft lengths
Pipe Burst/Replacement	3200	LF	$450.00	$1,440,000.00	
Nonhazardous Disposal	7500	TON	$50.00	$375,000.00	
Additional Costs*	1	LS	$493,750.00	$493,750.00	
Total				**$2,500,000.00**	

* - Additional costs include erosion & sedimentation controls, permits, supervision, engineering, pumping/disposal of water, etc.

Table 2
Analysis of Alternatives
Skokie Ditch Repair/Relocation

Option 2 - Re-Route Pipes through Middle Route - Trench Box

Item	Quantity	Unit	Unit Cost	Total Cost	
Mobilization	1	LS	$60,000.00	$60,000.00	
Excavation	18000	CY	$4.00	$72,000.00	use 15 ft trench width for vol calcs
Pipe Bedding	4400	LF	$45.00	$198,000.00	
Pipe	4400	LF	$75.00	$330,000.00	
Backfill	16400	CY	$2.50	$41,000.00	
Compaction	18000	CY	$2.00	$36,000.00	
Nonhazardous Disposal	11250	TON	$50.00	$562,500.00	
Top Soil	1600	CY	$20.00	$32,000.00	
Grass/Hydroseed	43200	1000 SF	$100.00	$4,320.00	
Grout Existing Pipe	690	CY	$120.00	$82,800.00	$77 per CY Cost of Lean Concrete
Haul Away Excess Soil	3600	CY	$4.00	$14,400.00	Add 50% for labor & equip. to grout
Additional Costs*	1	LS	$358,255.00	$358,255.00	
Total				**$1,800,000.00**	

* - Additional costs include erosion & sedimentation controls, permits, supervision, engineering, pumping/disposal of water, etc.

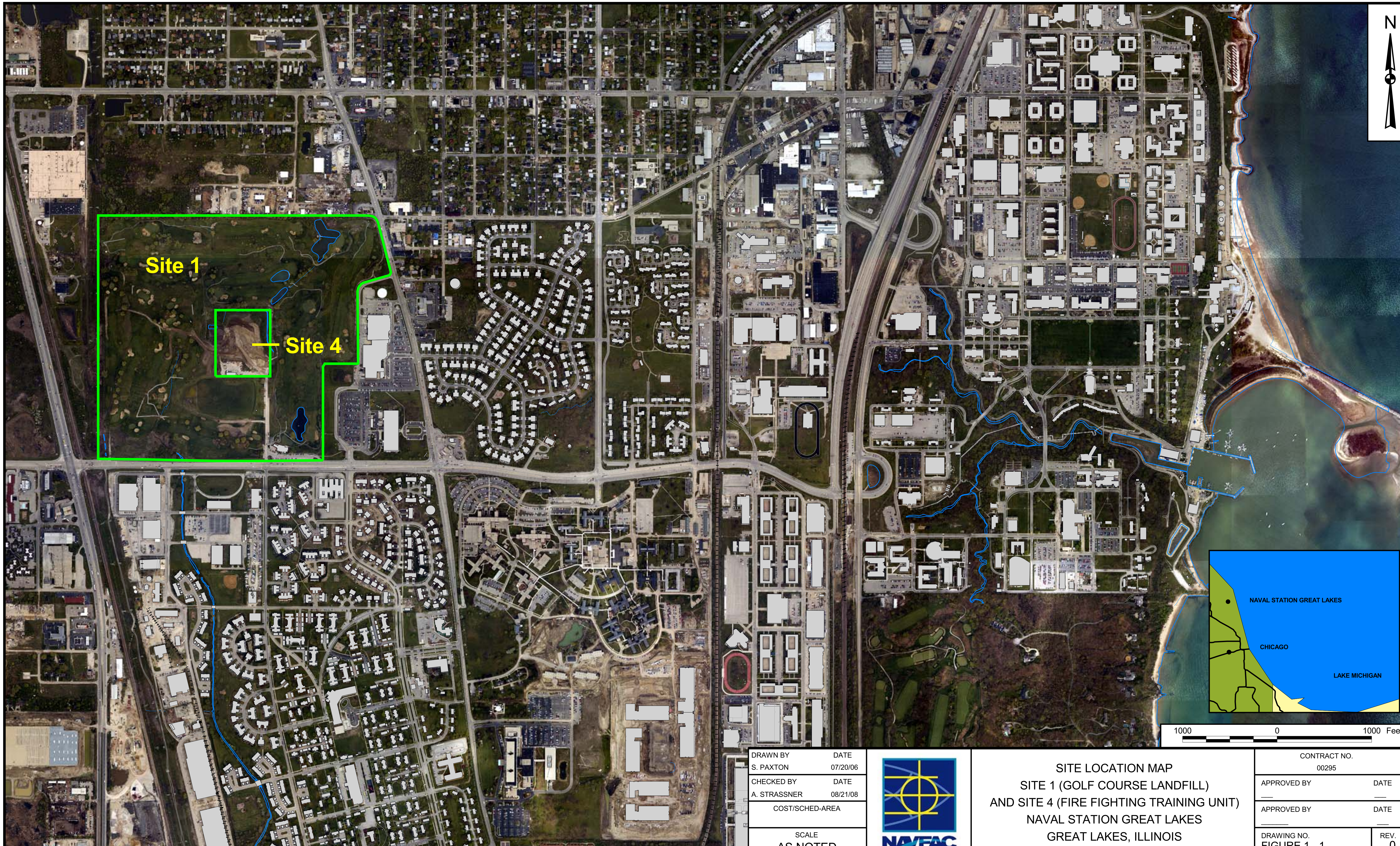
Table 3
Analysis of Alternatives
Skokie Ditch Repair/Relocation

Option 3 - Re-Route Pipes through Southern Route - Trench Box

Item	Quantity	Unit	Unit Cost	Total Cost	
Mobilization	1	LS	$60,000.00	$60,000.00	
Excavation	20000	CY	$4.00	$80,000.00	use 15 ft trench width for vol calcs
Pipe Bedding	6000	LF	$45.00	$270,000.00	
Pipe	6000	LF	$75.00	$450,000.00	
Backfill	19000	CY	$2.50	$47,500.00	
Compaction	20000	CY	$2.00	$40,000.00	
Top Soil	2200	CY	$20.00	$44,000.00	
Grass/Hydroseed	60000	1000 SF	$100.00	$6,000.00	
Grout Existing Pipe	690	CY	$120.00	$82,800.00	
Haul Away Excess Soil	3000	CY	$4.00	$12,000.00	
Additional Costs*	1	LS	$273,075.00	$273,075.00	
Total				**$1,400,000.00**	

* - Additional costs include erosion & sedimentation controls, permits, supervision, engineering, pumping/disposal of water, etc.

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE1.APR SITE LOCATION MAP LAYOUT 08/21/08 JEE



DRAWN BY S. PAXTON	DATE 07/20/06	SITE LOCATION MAP SITE 1 (GOLF COURSE LANDFILL) AND SITE 4 (FIRE FIGHTING TRAINING UNIT) NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NO. 00295
CHECKED BY A. STRASSNER	DATE 08/21/08		APPROVED BY — DATE —
COST/SCHED-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 1 - 1 / REV. 0

P:\GIS\GREATLAKES_NS\MAPDOCS\APR\SITE1.APR RELOCATION OPTIONS LAYOUT 08/21/08 JEE

DRAWN BY	DATE
J. ENGLISH	04/22/08
CHECKED BY	DATE
A. STRASSNER	08/21/08
COST/SCHED-AREA	
SCALE AS NOTED	

NAVFAC

RELOCATION OPTIONS
SITE 1 - GOLF COURSE LANDFILL
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NO. 00078	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 2 - 1	REV. 0

APPENDIX C

BORING LOGS

Site 1 - Golf Course Landfill
Summary of Borings that Encountered Landfill Waste
Cover Analysis

Project	Test Boring	Cover Thickness (ft)	Soil Cover	Soil Color
NTC01SB	88	4.5	silty clay	brown
NTC01SB	89	8.5	silty clay	brown
NTC01SB	90	8.0	silty clay	brown
NTC01SB	91	7.5	silty clay	brown
NTC01SB	92	5.5	silty clay	brown
NTC01SB	93	7.0	silty clay	brown
NTC01SB	94	14.0	silty clay	brown
NTC01SB	95	1.5	silty clay	brown
NTC01SB	96	4.0	silty clay	brown
NTC01SB	98	13.0	silty clay	brown
NTC01SB	99	5.0	silty clay	brown
NTC01SB	100	3.5	silty clay	brown
NTC01SB	102	3.0	silty clay	brown
Average		**6.5**		

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB088
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB088

Depth (ft bgs)*	Run No.	Run % Recvy	Lithology USCS	Lithology Primary Color	Lithology Moisture	Lithology Primary Description	Lithology Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	67	OL	black	DRY	SILTY CLAY	with ash gravel layer from 1.7-1.8	0
1								0
2								0
3								0
4	2	60	WASTE	other - describe	DRY	WASTE	silty clay sands wood plastic ceramic glass	0
5								0
6								0
7								0
8	3	37						0
9								0
10								0
11			CH	black	DRY	SILTY CLAY	black to brown	0
12	4	100						0
13								0
14								0
15			CL	light brown	WET	SILTY CLAY	some clay grading to more clay with depth	0
16	5	100						0
17			CL	grey	SAT	CLAY		0
18								0
19								0
20	6	100						0
21								0
22								0
23								0

End of Boring: 24 feet bgs
Notes: None

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB089
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB089

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	21	CL	brown	DRY	SILTY CLAY	with ash vegetation lens from 5.3-5.5 ft. bgs	0
1								0
2								0
3								0
4	2	87						0
5								0
6								0
7								0
8	3	62	WASTE	black	DRY	WASTE	ash waste fine-very fine sand silt clay	0
9								0
10								2.5
11								0
12	4	40						0
13								0
14								0
15			CL	brown	DRY	SILTY CLAY	with gravel in upper 2"	0
16	5	70						0
17								0
18								0
19								0
20	6	100	CL	grey-brown	DRY	CLAY with sand and silt	silty clay with fine to coarse sands and much silts.	0
21								0
22								0
23								0

End of Boring: 24 feet bgs
Notes: None

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB090
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB090

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	75	CL	brown	DRY	SILTY CLAY	silty clay to clay with larger gravel (to 1") at 1.9 to 2.1' bgs	0
1								0
2								0
3								0
4	2	95						0
5								0
6								0
7								3.5
8	3	62	WASTE	black	WET	SAND - poorly graded	Black waste with silts and very fine sands. glass brick concrete and wood. saturated in some areas.	0
9								0
10								0
11								0
12	4	0						0
13								0
14								0
15								0

End of Boring: 16 feet bgs
Notes: Near abandoned well NTC01TW04.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Boring ID: NTC01SB090-Well
Start Date: 12/15/2006
Project Number: 112G00295
Geologist: Scott Anderson
End of Boring Date: 12/15/2006
Drilling Company: EFS, Inc.
Lead Driller: Jay McFall
Background PID Screening: 0 ppm
Drilling Rig: 6600 Series Track Rig
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): Yes (NTC01TW04)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB090-Well								Analytical Results - Screening
	Run		Lithology					
Depth (ft bgs)*	No.	% Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	PID - sample
0	1	42	CL-ML	brown	DMP	SILTY CLAY	sc with minor fine vegetation and minor f - m subrounded quartz sand and some rock frag gravel. possiblr rare mn nodules at 6 and below	0
1								0
2								0
3								0
4	2	97						0
5								0
6								0
7			SC-ML	brown	DMP	SILTY CLAY	sc as above but with 0.2 layer of waste at 7.3 to 7.5 and glass layer at 7.9 to 8.0 - large yellow	0
8	3	70						0
9								0
10								0
11			SP-SM	black	WET	WASTE	silty some clay to f to m waste - mostly quartz - concrete frags glass. some very f sand near 14.5. wood above 14 to maybe 12. very wet/saturated at 15.	0
12	4	58						0
13								0
14								0
15								0
			CL-ML	light brown	DMP	SILTY CLAY	sc like above waste but increasing clay with depth. wettish with f quartz sand at 18.5 to 19.	
16	5	82						0
17								0
18								0
19								0
	6	0						

End of Boring: 20 feet bgs
Notes: Exploratory hole drilled with DPT prior to installation of temporary monitoring well NTC01TW04. Well drilled to total depth of 18.7 feet bgs screened from 7 is centered on waste area where saturated zone was observed.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB091
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB091

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening: PID - sample
0	1	67	CL	brown	DRY	SILTY CLAY	with clay and organic layer (ash?) from 4.9-5.3 ft bgs	0
1								0
2								0
3								0
4	2	90						0
5								0
6								0
7								0
7.6			WASTE	black	DMP	WASTE	silty waste with clayey zones much plastic ceramic paper concrete flakes metal	
8	3	47						2.1
9								0
10								0
11								0
12	4	45						0
13								0
14								0
15								0
15.4			CL	brown	DRY	SILTY CLAY	brown to green grades to sandy clay at 18 to 20' bgs	
16	5	100						0
17								0
18								0
19								0
20	6	77						0
21								0
21.5			CL	grey	DRY	CLAY		
22								0
23								0

End of Boring: 24 feet bgs
Notes: None

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB092
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB092

Depth (ft bgs)*	Run No.	Run % Recvy	Lithology USCS	Lithology Primary Color	Lithology Moisture	Lithology Primary Description	Lithology Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	42	CL	brown	DRY	SILTY CLAY	with burn layers from 4.0 to 4.7' bgs	0
1								0
2								0
3								0
4	2	100						0
5								0
			WASTE	black	SAT	WASTE	fine to very fine silt with clayey areas glass ceramic upper portion is clean and layered silty clay	
6								0
7								0
8	3	47						0
9								0
10								0
11								0
12	4	47						0
13								0
14								1.1
15								0
16	5	75						0
			CL	brown	DRY	SILTY CLAY	brown-gray sandy silty clay	
17								0
18								0
19								0
20	6	75						0
21								0
22			CL	grey	DRY	CLAY		0
23								0

End of Boring: 24 feet bgs
Notes: None

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB093
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB093

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening: PID - sample
0	1	77	CL	brown	DRY	SILTY CLAY	with fine to medium sands from 3.6 to 4.2' bgs	0
1								0
2								0
3								0
4	2	80						0
5								0
6								0
7			WASTE	black	SAT	WASTE	layered with silty clay at 7.2-8.0 9.7-11.0 15.3-16.0 ft. bgs	0
8	3	97						2.6, 2.9
9								0
10								0
11								0
12	4	42						0
13								0
14								0
15								0
16	5	60	CL	brown	WET	SILTY CLAY	wet to 22.0 ft. bgs.	0
17								0
18								0
19								0
20	6	77						0
21								0
22			CL	grey	WET	SILTY CLAY		0
23								0

End of Boring: 24 feet bgs
Notes: None

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB094
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB094

Depth (ft bgs)*	Run No.	Run % Recv	Lithology USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	70	CL	brown	DRY	SILTY CLAY	silty clay to clay with gravel from 4 to 4.1 6 to 6.4 and some organic (burned) layers	0
1								0
2								0
3								0
4	2	65						0
5								0
6								0
7			CL	brown	DRY	SILTY CLAY		0
8	3	100						0
9								0
10								0
11								0
12	4	90						0
13								0.6
14			WASTE	black	SAT	SAND with silt	black very fine sand and silts with little glass plastic and ceramic	0
15								0
16	5	100						0
17								0
18								0
19								0

End of Boring: 20 feet bgs
Notes: Near abandoned temporary monitoring well NTC01TW03.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Boring ID: NTC01SB094-Well
Start Date: 12/15/2006

Project Number: 112G00295
Geologist: Scott Anderson
End of Boring Date: 12/15/2006

Drilling Company: EFS, Inc.
Lead Driller: Jay McFall
Background PID Screening: 0 ppm

Drilling Rig: 6600 Series Track Rig
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): Yes (NTC01TW03)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB094-Well

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening: PID - sample
0	1	65	CL-ML	brown	DMP	SILTY CLAY	HARD TO VERY HARD SILTY CLAY WITH minor m-c quartz and rock frag sands and rare gravel - subrounded	0
1								0
2								0
3								0
4	2	75						0
			SP-SM	black	DRY	SILT with sand	ash/burn layer with gravel/concrete frags and mn nodules. mostly f-c subrounded sands and silt.	
5								0
6								0
			CL-ML	brown	DMP	SILTY CLAY	same as 0 to 4.5. grading to clayey with moderate plasticity.	
7								0
8	3	100						0
9								0
10								0
11								0
12	4	85	SC-SM	black	WET	WASTE	silty clayey and sand quartz - vf to c subrounded - and glass metal. vf and lense at 16 for 1 foot.	0
13								0
14								0
15								0
16	5	52						0
17								0
18								0
19								0
20	6	75						0
21			SC-ML	light brown	DMP	SILTY CLAY	similar to above but grading toward gray clay with plasticity then very hard at lower 1 foot	0
22								0
23								0
24	7	0						

End of Boring: 24.4 feet bgs
Notes: Exploratory hole drilled with DPT prior to installation of temporary monitoring well NTC01TW03. Well drilled to total depth of 24.4 feet bgs screened from 1:
Screen is centered on waste area where saturated zone was observed.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB095
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB095

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	42	CL	brown	DRY	SILTY CLAY	with vegetation	0
1			WASTE	black	DRY	WASTE	interlayed silty clay and waste of 0.5 feet intervals. waste is wood and concrete. medium sand from 7.7 to 8.2' bgs.	0
2								0
3								0
4	2	55						0
5								0
6								0
7								0
8	3	100						2.1
9								0
10								0
11			CL	brown	WET	SANDY CLAY	and silty clay	0
12	4	77						0
13								0
14								0
15			CL	brown	DRY	SILTY CLAY	brown to gray silty clay with gravel from 16.0 to 16.4' bgs.	0
16	5	100						0
17								0
18								0
19								0
20	6	100						0
21								0
22								0
23								0

End of Boring: 24 feet bgs
Notes: Boring offset to the east approximately 15 feet due to concrete storm culvert.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB096
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB096

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	87	OL	black	DRY	SILTY CLAY	organic layer from 2.3-2.4 ft. bgs	0
1								0
2								0
3								0
4	2	62	WASTE	black	DRY	WASTE	silty clay and waste large gravel from 7.5 to 7.7' bgs brick and concrete at 12' bgs.	0
5								0
6								0
7								0
8	3	77						0
9								2.7
10								0
11								0
12	4	100						0
13			CL	grey	DRY	SILTY CLAY	and clay	0
14								0
15								0

End of Boring: 16 feet bgs
Notes: Refusal on concrete at 8 ft. bgs at first attempt (GIS/map location). Final hole offset approximately 6 feet east.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB098
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/19/2006
End of Boring Date: 12/19/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB098

Depth (ft bgs)*	Run No.	Run % Recvy	Lithology USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	25	CL	brown	DRY	SILTY CLAY	with gravel at 5.1-5.2 7.6-7.7 and 9.1-9.3 ft. bgs	0
1								0
2								0
3								0
4	2	82						0
5								0
6								0
7								0
8	3	100						0
9								0
10								0
11								0
12	4	67						0
			WASTE	other - describe	DRY	WASTE	with layers of silty clay at 14.9-15.4 15.9-16.1 and 16.5-16.9 ft. bgs	
13								0
14								0
15								0
16	5	62						0
17								0
18								0
19								0
			CL	brown	DRY	CLAY	brown to gray	
20	6	100						0
21								0
22								0
23								0

End of Boring: 24 feet bgs
Notes: None

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB099
Geologist: Scott Anderson
Lead Driller: Steve Gaiser
Drilling Method: Direct-Push Technology

Start Date: 12/19/2006
End of Boring Date: 12/19/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB099

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening: PID - sample
0	1	35	CL	brown	DRY	SILTY CLAY	silty clay with some clayey areas and minor vegetation. large gravels at 0.5 to 0.6 4.3 to 4.4 and 5.0' bgs. minor vegetation and some large gravel.	0
1								0
2								0
3								0
4	2	97						0
5			OTHER	black	DRY	SAND fine to silty	black waste with metal frags plastic and brick and some intermixed silty clays. Silty clay is layered with waste.	0
6			WASTE	black	DRY	SAND fine to silty	sandy waste with ash/burn layers (mn nodules coke) glass and plastic. few metal frags.	0
7			OTHER	black	DRY	SAND fine to silty	Waste and silty clay mixture as observed in 5 to 6.1' bgs. Brick at 8.6' bgs.	0
8	3	72						0
9			WASTE	black	DMP	SILT with sand	Silty waste with metal glass ceramic plastic.	0
10								0
11			CL	brown	MST	SILTY CLAY	brown silty clay with minor gravel.	0
12	4	75	OTHER	brown	SAT	SAND with silt	Alternating layers of 0.4' thick waste and silty clay. At least 3 zones of each some slightly thicker.	0
13								0
14								0
15								0
16	5	70	WASTE	black	SAT	SAND with silt	waste with silts composed of metal glass brick etc.	0
17								0
18								0
19								0
			CL	brown	DMP	SILTY CLAY	silty clay to clay with minor gravels. brown to green with depth.	

End of Boring: 20 feet bgs

Notes: At least 5 DPT holes drilled generally all within 6 feet of each other in order to provide enough subsurface material for sampling. DPT holes ranged in deptl deep. Slight variations in depths and thicknesses of lithologies between holes however variations are insignificant as same number and styles of units observed in abandoned temporary monitoring well NTC01TW01.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB099-Well
Geologist: Scott Anderson
Lead Driller: Jay McFall
Drilling Method: Direct-Push Technology

Start Date: 12/13/2006
End of Boring Date: 12/13/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): Yes (NTC01TW01)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB099-Well

Depth (ft bgs)*	Run No.	Run % Recvy	Lithology USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	43	CL	brown	DRY	SILTY CLAY	brown silty clay with vegetation and some very clayey areas. occaisional larger gravels.	0
1								0
2								0
3								0
4	2	100						0
5			WASTE	black	SAT	SAND with silt	Waste generally a silty or sandy silt with layered silty clay to clay zones. Waste is brick metal ceramic plastic mn nodules coke glass.	0
6								0
7								0
8	3	60						0
9								0
10								0
11								0
12	4	87						0
13								0
14								0
15								0
16	5	62						0
17								0
18								0
19								0
20	6	100	CL	grey-brown	DMP	SILTY CLAY	silty clay to clay grading from brownish to greenish-gray with depth.	0
21								0
22								0
23								0
24	7	100						0
25								0

26							0
27							0

End of Boring: 28 feet bgs
Notes: Exploratory hole drilled with DPT prior to installation of temporary monitoring well NTC01TW01. Well drilled to total depth of 22.5 feet bgs screened from 6
is centered on waste area where saturated zone was observed.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Boring ID: NTC01SB100
Start Date: 12/19/2006
Project Number: 112G00295
Geologist: Scott Anderson
End of Boring Date: 12/19/2006
Drilling Company: EFS, Inc.
Lead Driller: Steve Gaiser
Background PID Screening: 0 ppm
Drilling Rig: 6600 Series Track Rig
Drilling Method: Direct-Push Technology
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB100

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening: PID - sample
0	1	75	CL	brown	DRY	SILTY CLAY	silty clay with very clayey areas and minor vegetation. black organic vegetation layer 0.1 thick from 1.1 to 1.2' bgs.	0
1								0
2								0
3								0
			WASTE	black	SAT	SAND-SILT mix	upper 1' ash/burn with glass then gravel metal and ceramic. Interlayered with silty clay and silty areas (up to 0.5 feet thick). Metal shards and wood at 10 to 12' bgs. silt to coarse sand/fine gravel at base.	
4	2	62						0
5								0
6								0
7								0
8	3	35						0
9								1.7
10								0
11								0
12	4	22						0
13								0
14								0
15								0
16	5	22						0
17								0
18								0
19								0
			CL	grey-brown	DRY	SILTY CLAY	brown transitioning to gray silty clay and clay.	
20	6	100						0
21								0
22								0
23								0

End of Boring: 24 feet bgs
Notes: Near abandoned temporary monitoring well NTC01TW02.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB100-Well
Geologist: Scott Anderson
Lead Driller: Jay McFall
Drilling Method: Direct-Push Technology

Start Date: 12/14/2006
End of Boring Date: 12/13/2006
Background PID Screening: 0 ppm
Convert To Well? (Well ID): Yes (NTC01TW02)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB100-Well

Depth (ft bgs)*	Run No.	Run % Recvy	USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	77	CL-ML	brown	DRY	SILTY CLAY	brown silty clay with some minor vegetation and very clayey areas.	0
1								0
2								0
3								0
4	2	55	WASTE	black	SAT	SAND fine grained	black sand to very fine sand to silt with metal wire glass concrete wood.	0
5								10.6
6								0
7								0
8	3	32						0
9								1.1
10								0
11								0
12	4	21						0
13								0
14								0
15								0
16	5	75						0
17								0
18								0
19			CL	grey	DRY	SILTY CLAY	silty clay to clay	0
20	6	0						

End of Boring: 20.6 feet bgs
Notes: Exploratory hole drilled with DPT prior to installation of temporary monitoring well NTC01TW02. Well drilled to total depth of 20.6 feet bgs screened from 4
is centered on waste area where saturated zone was observed.

Tetra Tech NUS, Inc.

BORING LOG

Project Name: GREAT LAKES NTC - Landfill Delineation and Miscellaneous Sampling - Phase I - Site 1
Project Number: 112G00295
Drilling Company: EFS, Inc.
Drilling Rig: 6600 Series Track Rig

Boring ID: NTC01SB102
Geologist: Bloom Consultants
Lead Driller: Jay McFall
Drilling Method: Direct-Push Technology

Start Date: 12/18/2006
End of Boring Date: 12/18/2006
Background PID Screening: 1.7 ppm
Convert To Well? (Well ID): No (N/A)

Landfill Delineation and Miscellaneous Sampling - Boring ID: NTC01SB102

Depth (ft bgs)*	Run No.	Run % Recy	Lithology USCS	Primary Color	Moisture	Primary Description	Secondary Descriptors	Analytical Results - Screening PID - sample
0	1	37	CL-ML	brown	DRY	SILTY CLAY	brown silty clay with sand	0
1								0
2								0
3			WASTE	black	SAT	SAND - poorly graded	black sand and gravels	0
4	2	62	WASTE	black	SAT	SAND - poorly graded	black sands with minor plastic and metal fragments	0
5								0
6								0
7								0
8	3	100	CL	brown	DRY	SILTY CLAY	brown-greenish clay with subrounded gravel to 1/2"	0
9								0
10								0
11								0
12	4	100						0
13								0
14								0
15								0
16	5	100	CL	grey-green	DRY	SILTY CLAY	silty clay	0
17								0
18								0
19								0

End of Boring: 20 feet bgs
Notes: None

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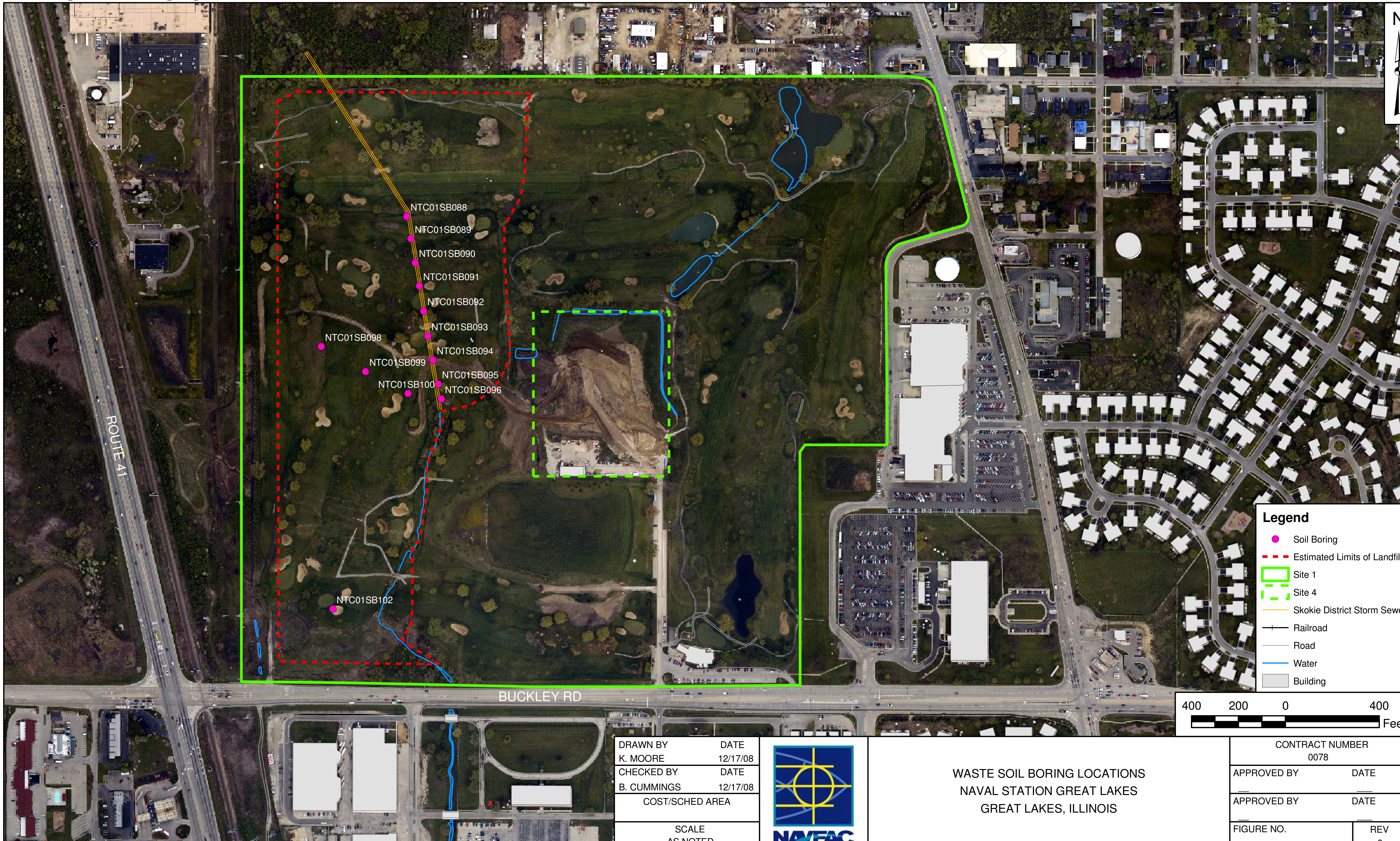


DRAWN BY	DATE
K. MOORE	12/17/08
CHECKED BY	DATE
B. CUMMINGS	12/17/08
COST/SCHED AREA	
SCALE AS NOTED	

NAVFAC

WASTE SOIL BORING LOCATIONS
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER 0078	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO.	REV 0

APPENDIX D

CALCULATIONS

TETRA TECH NUS, INC. **CALCULATION SHEET**

CLIENT: Naval Training Center		JOB NUMBER: CTO 506
SUBJECT: Sites 1 and 4 FS - Area and Waste Volume Calculations		
BASED ON:		DRAWING NUMBER: 1 of 1
BY: BDC Date: 4/21/08	CHECKED BY: Date:	APPROVED BY: DATE:

SITE 1 GOLF COURSE LANDFILL - IMPACTED SOIL ESTIMATES

A landfill was operated at Sites 1 and 4 between 1942 and 1967 as a trench/burn facility. It received an estimated 1.5 million tons of material total during its years of operation, and is approximately 50 acres in size. Types of waste reportedly disposed at the landfill included domestic refuse, sewage sludge, petroleum, oil, lubricants, solvents, coal ash, and materials contaminated by polychlorinated biphenyls (PCBs) (C.H. Guernsey, November 2002). A dragline was used for excavation of the trenches. Each trench was approximately 8 feet wide and was dug to at least the top of the water table (6 to 8 feet in this area). Occasionally, the trenches had several feet of standing water in the bottom. General refuse and trash were disposed directly into these trenches. Free liquid oil, such as waste engine oil from activity shops, was also disposed in this manner. After a significant volume of material was placed in a trench, the pile was ignited and allowed to burn. Proceeding in this manner, the trenches were progressively filled and covered from west to east and north to south (Rogers, Golden & Halpern,

Estimated Area =	50	acres
Depth to Waste =	2	ft
Thickness of Waste =	10	ft
% "Clean" Material (exc. cover) =	50	%
% Non-Haz Waste Material =	25	%
% Haz Waste Material =	25	%
Total Volume of Excavation =	26136000	cft
	968000	cyds
Volume of cover soils =	4356000	cft
	161000	cyds
Volume of "clean"soils (less cover) =	10890000	cft
	403000	cyds
Volume of non-haz waste =	5445000	cft
	202000	cyds
Volume of haz waste =	5445000	cft
	202000	cyds

SITE 1 GOLF COURSE LANDFILL - ESTIMATED EXCAVATION COSTS

Estimate Cost (based on the assumption that soil excavation = $3/cyd, placement is $4/cyd, disposal cost are $50/cyd for non-haz and $75/cyd for haz.)

	Volume	Unit Cost	Cost
Soil Excavation	968000	$ 3	$ 2,904,000
Soil Placement	968000	$ 4	$ 3,872,000
Non Haz Disposal	202000	$ 50	$ 10,100,000
Haz Disposal	202000	$ 75	$ 15,150,000
Total Cost Estimate			**$ 32,026,000**

APPENDIX E

COSTS

CLIENT: Naval Training Center		JOB NUMBER: CTO 506
SUBJECT: Sites 1 and 4 FS - Alternative 2: Capital Cost - Containment, Institutional Controls, Monitor and Maintenance		
BASED ON:		DRAWING NUMBER: 1 of 2
BY: BDC Date: 4/21/08	CHECKED BY: ALS Date: 4/29/08	APPROVED BY: DATE:

Alternative 2: Containment, Institutional Controls, Monitoring

Annual Cost

Cover Inspection & Report (1 person)

car & per diem @ $200/day =	$400	
Hours	$2,600	(40 hours * $65/hr for field & report)
Misc	$250	
	$3,250	

Cover Maintenance

Assume golf course will maintain cover including repair of erosion and any areas of the cover identified that are less than 3 feet thick.

Sampling

Labor & Materials, per round (3 wells per day: 12 wells + 6 surface water samples per day)
Assume 6 days to sample with 2 people, local

2 people @ $60.00 per hour for 10 hours per day for 6 days =	$7,200
car for 6 days =	$600
per diem @ $300/day =	$1,800
report @ $65.00 per hour for 6 hours =	$390
Misc supplies, copying, etc. =	$350
	$10,340

Analytical, per round for 30 years
Collect water samples from wells and analyze for CVOCs, dioxins/furans, & metals

type	cost each	number	total
CVOCs	$75	24	$1,800
dioxins/furans	$650	24	$15,600
metals	$125	24	$3,000
			$20,400
40% QA/QC & Data Validation			$8,160
			$28,560

Sampling report; assume $5,000 per round $5,000

Five Year Review

5-year review say $17,000

CLIENT: Naval Training Center		JOB NUMBER: CTO 506
SUBJECT: Sites 1 and 4 FS - Alternative 2: Capital Cost - Containment, Institutional Controls, Monitor and Maintenance		
BASED ON:		DRAWING NUMBER: 2 of 2
BY: BDC Date: 4/21/08	CHECKED BY: ALS Date: 4/29/08	APPROVED BY: DATE:

Alternative 2: Containment, Institutional Controls, Monitoring, and Maintenance

Capital Costs:

Institutional Controls (estimated)

Land Use Contol Remedial Design (LUCRD) =	$15,000
Warning Signs =	$10,000
	$25,000

Surface Water Management - Skokie Ditch Relocation (One Time Charge)

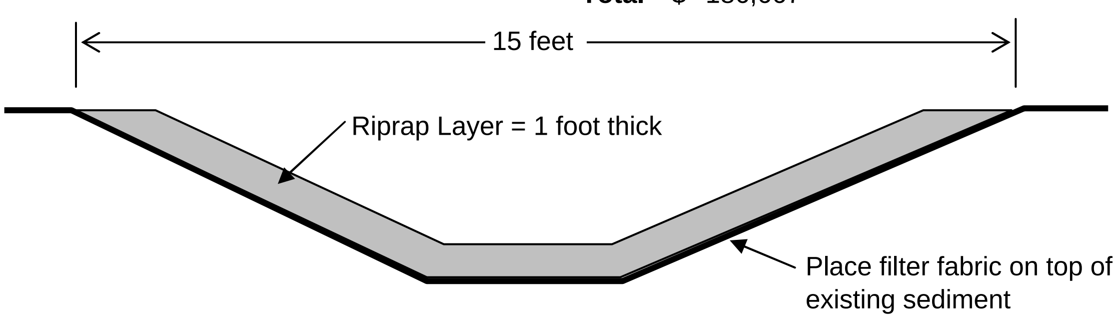
Pipe Location (reference Tech Memo) = $1,400,000

Sediment Protection - Skokie Ditch Riprap

Length =	1400	feet
Width =	15	feet
Area =	21000	
Use Thickness of Riprap =	1	foot
Volume =	778	cyds
at 2.25t/cyd Weight =	1750	tons

Costs

Fabric @ $5/syd =	$ 11,667
Riprap @ $100/ton installed =	$ 175,000
Total	$ 186,667



Present Worth:

using 30 year period and a discount rate of 7%

Annual Costs =	$47,150	$585,086
Five Years =	$17,000	$36,683
Capital =		$1,611,667
Present Worth Estimate =		**$2,233,436**